

POPULAR SCIENCE

SM

MONTHLY

SEPTEMBER

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AN UNUSUAL ARTICLE:

Queer Vehicles Inventors Produce . . . PAGE 26

NEW INVENTIONS • MECHANICS • MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS • 350 PICTURES

ROAD SHOCK!

*the steering gear takes
punishment every second*



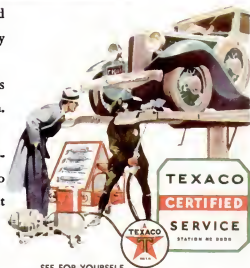
The grinding friction of crushing pressures, severe impacts and road shocks that the steering gear is forced to carry would quickly destroy this vital element without effective lubrication.

The steering gear lubricant must keep these metal surfaces apart! It's a service that only an extraordinary lubricant can effectively perform. Texaco Marfak Grease was made for high pressure service.

And now Texaco Certified Lubrication, with special, new power equipment, has made this unusual lubricant available to motorists. Texaco Marfak clings to the bearings and resists tremendous pressures. Stop at any Texaco Certified Station.

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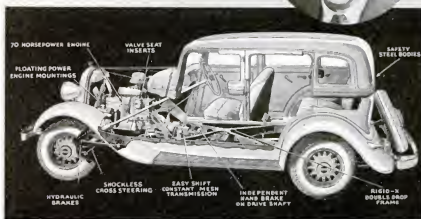
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"I looked at All Three —WITH AN X-RAY EYE"

A CERTIFIED INTERVIEW WITH G. R. STEVENS, 1006 SPRING STREET, ELGIN, ILLINOIS



"Plymouth sounded good on paper..."



"... But I wanted to see for myself so I dug deep down under the paint."



"That engine runs like a fine watch."



"My wife likes its smart appearance as much as I like its engineering."

"These Features convinced me Plymouth gives More for the Money!"

"I'm an engineer in a watch factory, where we look at machinery through magnifying glasses."

And that's how Mr. Stevens went looking for a new car. When he compared "all three" he took off hoods and looked under floor-boards.

He says: "I picked Plymouth because it's a piece of true precision engineering...not just a lot of automobile 'parts' put together."

More for your money. That's why

Plymouth sales have doubled in 12 months. More comfort features like Floating Power engine mountings.

Greater safety with Safety-Steel Bodies and Hydraulic Brakes. Easier driving with Constant Mesh Transmission. And...ask any Plymouth owner...greater pride of ownership.

\$445

AND UP F.O.B. FACTORY, DETROIT

Standard; 2-door sedan \$465; 4-door sedan \$510; rumble coupe \$485; business coupe \$445. De Luxe; 2-door sedan \$525; 4-door sedan \$575; conv. coupe \$595; rumble coupe \$545; business coupe \$495. All prices, F. O. B., subject to change without notice. SEE PLYMOUTH AT CHRYSLER MOTORS BUILDING, CHICAGO CENTURY OF PROGRESS

NEW PLYMOUTH SIX WITH PATENTED FLOATING POWER

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ARTHUR WAKELING, Home Workshop Editor
ALDEN P. ARMAGNAC, Associate Editor
SYDNEY OXBERRY, Art Editor

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"It's Good to Hear Your VOICE"

THIS very day the telephone will touch the lives of millions of people. To a modest home in the suburbs, it will carry words of love and comfort and the assurance that all is well. In another home, a housewife, busy with her work, will pause a little while to place her daily orders or answer a welcome call from a friend. To some one else, the ring of the telephone may mean good news about a position or a business transaction.

To have a telephone in your home

is to hold your place in the world of people—to keep unbroken your contact with those whose help and friendship are so essential.

Individuals employ the telephone in many different ways. The busy, to save time. The friendly, to win more friendship. The lonely, to make contacts. The troubled, to find comfort and reassurance. The frightened, to call for aid. The gay, to share their gaiety. It is through the medium of the telephone that

thoughts become words and words become messengers between one human mind and another, defying space and time and all the elements that would interpose delays and doubts.

The value of the telephone can be measured only by measuring the activity of the people who use it and the diversity of life itself.



**AMERICAN TELEPHONE
AND TELEGRAPH COMPANY**

You are cordially invited to visit the Bell System Exhibit in the Communication Building, Century of Progress Exposition, Chicago

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions



■ WHAT GOOD ARE SQUARE GEARS?

Possibly you never heard of square gears. You might even laugh at the idea and say that square gears would be about as useless as square automobile wheels. Yet, properly mounted and meshed, square gears not only work but supply the only known way of causing certain machines to operate as required.

50,000 A WEEK SEE SQUARE GEARS WORK

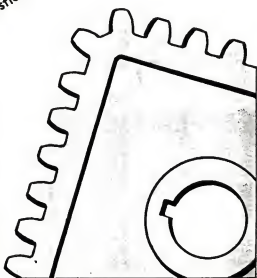
You can see square gears working and moving twelve hours every day at The Mechanical Wonderland, Popular Science Monthly's exhibit at the great Chicago World's Fair. These gears are only one of 160 moving, working models that form the most vivid, understandable, and instructive demonstration of the principles of mechanics ever made. From the moment it was put in operation Popular Science Monthly's exhibit has been one of the most popular spots in the whole Exposition. An automatic counting machine recorded more than 50,000 visitors to the Popular Science Monthly booth in a single week.

"AN EDUCATION IN ENGINEERING"

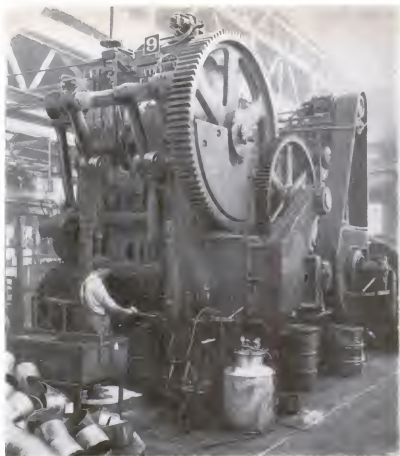
"Your exhibit is an education in engineering for the public," wrote an early visitor to the Fair. This man did not exaggerate. Every mechanical movement and principle employed in present-day machinery, from simple levers to the radial internal combustion engine used in aircraft, can be found in this unique collection of working models. Mr. W. M. Clark, originator and builder of the exhibit, and a group of assistants are in constant attendance at the booth to answer questions or perform any other similar service.

... Visit Popular Science Monthly at the WORLD'S FAIR

We are happy to repeat our invitation to visit our World's Fair Exhibit. The Mechanical Wonderland, which we present with the courteous cooperation of the Newark (N.J.) Museum, is situated in the Pavilion of Industrial Engineering, second floor, General Exhibits Building One, adjacent to the Hall of Science.



Back of reliability and reputations are research and careful construction. Photograph at right, shows a gigantic press used to form steel parts for one of the better grades of refrigerators



Our readers tell us some- thing about Buying AUTOMATIC REFRIGERATORS

DRYNESS as well as coldness is necessary to preserve food. This has been proved repeatedly by tests made by government health departments and other scientific institutions. Moisture and warmth, it has been found, alone foster the rapid growth of dangerous bacteria.

For this reason, there is little danger of food spoiling when it is placed in one of the recognized automatic refrigerators offered to the buying public. Like a tiny air-conditioning plant, the freezing coils not only cool and purify the air but dry it as well.

You probably have noticed at some time or other the snow-like frost that forms on the freezing unit of an automatic refrigerator. This frost does not come from within the unit but is moisture deposited there by the air as it circulates through the cabinet. Passing over the iced surfaces, it loses its moisture and odors and is cooled below fifty degrees Fahrenheit, the maximum allowable temperature for safe food storage.

An automatic refrigerator in your house is a safeguard on your health and the health of your family. Dangerous bacteria cannot grow in the dry cold atmosphere of its cabinet.

Aside from the health standpoint, an automatic refrigerator is an economy as well. In a test that lasted one whole year, a well-known home economist found that

her automatic refrigerator saved her \$120 by eliminating waste and improving her buying habits. With an automatic refrigerator, the housewife can safely store "left-overs," and purchase low-price "specials" for future use.

To be economical and safe, however,

an automatic refrigerator must be carefully designed and constructed from the best materials. Two items enter into the efficiency of its operation—mechanical construction and cabinet design. One without the other is useless. The entire refrigerator must be a balanced unit obtained by intensive engineering research and carefully supervised construction.

The question that enters the mind of a prospective buyer of an automatic refrigerator is: "How can I be sure that the refrigerator I buy is economical and will protect my food?" Unfortunately, the average person is not a mechanical expert nor is he an authority on heat-proof cabinets. To him, the purchase of a refrigerator takes on the aspect of the proverbial cat in the bag.

To find an answer to this question, POPULAR SCIENCE MONTHLY recently sent a carefully prepared questionnaire to 2,000 subscribers. Among other things, each reader was asked, "What influenced your decision on the make of automatic refrigerator you bought?"

In the greatest portion of cases the answer was, "Reputation." These readers realized that they were unable to judge a good refrigerator and eliminated any guesswork by buying a product of proved dependability and mechanical design. More important than price, appearance, and convenience, they felt, was the reputation of the concern that manufactured the product.

NOW READY

TWO valuable bulletins have been prepared for the readers of Popular Science Monthly. One is a new twenty-four-page specification list of the new 1933 radio sets compiled by the Popular Science Institute. It contains full information regarding tubes, prices, wave-lengths, and features. The other, a bulletin on air conditioning, outlines the types of air conditioning equipment now available to the home owner. There is no charge for these bulletins except postage. To cover first class mailing, send fifteen cents for the radio bulletin and six cents for the air conditioning bulletin. Both bulletins will be mailed to you for twenty-one cents.

WANTED

**MEN HANDY AT TINKERING
AROUND THE CAR • TO
TRY LAVA SOAP**

Car tinkers wanted! Amateur gardeners, tool Men handy at doing odd jobs around the house! All men—and women—who get their hands extra-dirty are wanted to try Lava Soap—to find out for themselves how quickly this hard-working, long-lasting cake gets the grimey hands clean.

Lava is made especially for extra-dirty hands. It contains fine, powdery pumice which gets even ground-in grime in less than a minute. Lava contains glycerine and other oils which soothe the tender skin. It saves you money because it outlasts ordinary toilet soaps 3 to 1.

Don't waste ordinary toilet soaps. Don't wash gobs of expensive lather down the drain. The very next time your hands get grimy, reach for a husky cake of Lava and watch the grime disappear like magic.

A Procter & Gamble Product

FREE—a full-sized cake of Lava. Address Procter & Gamble, Dept. 347, Box 1801, Cincinnati, Ohio. Give full name and address.



Gets the Dirt—Protects the Skin

STOP LEAKS MAKE LOOSE PARTS TIGHT

SMOOTH-ON No. 1 stops leaks of water, steam, oil, gas and smoke. Makes a pressure-tight seal at joints, cracks and breaks in pipes, boilers, radiators, tanks, ovens, hot-air and smoke ducts, pails, etc. Tightens loose handles on tools, cutlery, push brooms, umbrellas. Makes stripped nuts, bolts and screws hold. Tightens loose locks, hinges, casters, hooks, stems, chair arms and legs, posts set in metal or concrete, etc. Stops leaks in automobile radiators, hose connections, cracked water jackets and gear cases, oil and gasoline lines, keeps nuts, lubricator connections, hub caps and wood screws from coming loose, makes headlight and dash supports tight and proof against rattle. Applied cold and holds in any metal, concrete, masonry, tile or wood.

Home and car owners find uses for Smooth-On every month in the year and save from 50 cents to many dollars on each application. Making these emergency and routine repairs yourself avoids expense and delays for professional fixers and is easy if you follow instructions in the Smooth-On Repair Book, which will be mailed on request. Be ready the instant trouble shows up by keeping a can of Smooth-On in your repair kit and the booklet handy for quick reference.

Get the booklet from us and Smooth-On No. 1 in 7-oz., 1-lb., or 5-lb. tins from any hardware store.

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Dept. 58 370 Communipaw Ave.
Jersey City, N. J.

Do it with SMOOTH-ON



Write for
FREE BOOK

Everything You Need



to
make this
Cruiser

WITH a pocketknife, some single-edged razor blades, and a few simple tools that are to be found in every household, anyone can now build a beautiful 12 in. long model of the powerful new U. S. battle cruiser *Indianapolis*. Our complete kit of materials makes it easy—so easy, in fact, that the man or boy who has never before constructed a model is certain to be entirely successful.

The kit contains the hull block sawed to the correct outline and with the various deck "steps" cut out. With such a good start, you cannot fail to lay out the rest of the work accurately, especially as there is a blueprint and an illustrated instruction sheet to guide you.

In addition, there are seven pieces of white pine for making the various turrets, deck units, and lifeboats; round stock for the funnels and towers; sheet metal for rudder, propellers, shaft braces, and anchors; cardboard of the correct thickness for the funnel bases, turret mounts, and other parts; soft wire in two sizes for masts, derricks, guns, davits, cross arms, flagpoles, and the like; an envelope of cassin glue, and three bottles of the highest grade enamel.

Postpaid Complete \$1.50

Popular Science Homecraft Guild,
381 Fourth Ave., New York, N. Y.

Please send me a complete construction kit with enamel finishes and blueprint for building a 12-in. model of the U. S. cruiser *Indianapolis*. I enclose \$1.50.

Name.....

Address.....

City..... State.....

(Print very clearly)

A Bright Beautiful Car IN 4 MINUTES



SIMONIZ YOUR CAR

Then any dirt wipes off easily. Without bother or washing expense you can keep your car always looking new and beautiful!

A Simonized car is the easiest thing in the world to keep clean. After a dusty trip or some bad weather one stroke with a dry cloth makes the finish sparkling as ever!

Always Simoniz a new car. But if your car is dull you can make it look new in a jiffy with the wonderful Simoniz Kleener. There's nothing so easy to use, so quick or so fast, and so safe.

And, of course, every car needs the lasting, weatherproof protection of Simoniz to stay beautiful. Simoniz guards the finish wherever you go, makes it last longer, and keeps the colors from fading.

Your car will always look new if you use Simoniz and Simoniz Kleener. Nothing takes their place. Insist on them. At hardware and auto accessory stores everywhere.



MOTORISTS WISE • SIMONIZ

Our Readers Say



Patriotic Seagulls to Guard Coast Against Submarines

HERE'S an idea I think our navy should consider seriously. It sounds crazy, but it isn't. The idea is to train the seagulls along the coast to give warning if an enemy submarine approaches. The birds can see deep into the water and could easily spot a sub. Flocks of them always follow steamers because they know scraps and refuse will be thrown overboard. Why not train them to follow submarines as well by having our navy's under-water boats cruise up and down the coast regularly discharging garbage so the birds would associate submarines with food? Then, whenever an enemy boat approached the coast in wartime, flocks of seagulls would follow it, indicating its position and the direction it was traveling to patrol boats. I understand this idea was tried out along the British coast during the last months of the World War. But, of course, that was too short a time to train the birds. If our navy would start in now and carry out the experiment over a period of years, they could have the seagulls all trained to come to the aid of their country in case of another war.—J.D.O., Los Angeles, Calif.



Steam-Driven Airplane Raises Serious Question

REFERRING to your article, "World's First Steam-Driven Airplane," and to the italicized words, "Gains in efficiency the higher it goes," in particular. The statement may be true for the engine, but the engine is dependent upon the boiler pressure, the boiler pressure upon the heat supplied by the combustion of the fuel, and finally the combustion of the fuel upon the oxygen of the air. Wouldn't the thinness of the upper air produce approximately the same inefficiency with both external and internal combustion engines? They are both heat engines and any reduction of the necessary oxygen will impair their efficiency. I, and I believe others, would appreciate having this point explained.—P.E.F., Madison, Minn.

Money-Making Ideas In Your Magazine

AN UNEMPLOYED friend of mine tells me he has picked several dollars recently from ideas suggested to him by looking over back numbers of POPULAR SCIENCE MONTHLY. It occurs to me that your magazine, with its wealth of new ideas every month, should be helpful to people out of work. By looking over its pages, they might get ideas for repairing or odd job work which they could do in their community and in this way add materially to their income and so help meet the unavoidable food bill.—Mrs. R.R.S., Boston, Mass.



We're for Anything that Adds to the Joy of Life

ONE thing I have always liked about POPULAR SCIENCE MONTHLY is that you are never stodgy. Dignity is a fine thing but you apparently have discovered that, like a lot of other good things, it can be overcome. What I am getting at is that you consistently maintain a true sense of values with regard to the material you publish. Where a light touch is called for, even in your treatment of serious and important material, you never hesitate to use it. I have been pleased to see, too, in recent issues that the light touch has crept into your advertising columns. Two or three of your advertisers have used cartoons in calling attention to their wares. It's a good idea; effective and in key with modern trends. I for one read those advertisements and remember them and I hope others of your advertisers will take the cue and give us a laugh or two along with their regular messages.—C.W.R., Philadelphia, Pa.

Amateur Dissections Are What She's Interested In

BARRING the slightly sensational style, the Dr. Damrau articles on surgery were the most interesting of any series you have printed in a long while. I find, with mental agony, that the series is ended. Please, lend a gracious ear to an imploring reader. Give us more articles on modern surgery and amateur dissection. After all, this subject is far from being exhausted. If you can give such minute details on carpentry and other such scientific subjects, why not go farther with surgery? We want a more nearly complete history of surgery and we want more definite statements of what is yet needed in the surgical field. Give us some thoroughly scientific articles that will stir up the brain and let us see exactly what surgery is really about. In this plea I am voicing the cry of future surgical geniuses.—Miss C.M., Bronx, N. Y.



Hydrochloric Acid Will Dissolve Hard Water Sediment

IN A recent issue of POPULAR SCIENCE MONTHLY, L.D.J. asked if anything would dissolve the sediment formed when hard water is boiled. A good bet is commercial hydrochloric acid sold for cleaning cement off brick walls. It will dissolve any calcium carbonate (limestone) sediment, and cleans the deposit on our teakettle made from Washington's hard water. I want to say that P.C.G. is a nut if he thinks we are going to be threatened by his synthetic earthquakes because, in the first place, it is impossible to create such disturbances in a way that would destroy a city. In the second place, why invent new war machines

when we are trying to work toward world peace? Look what the World War did for us—our nice little depression is a result of it!—J.L., Washington, D. C.

Evolution and Religion Are Not in Opposition

AS AN attempt to come to something resembling a definite conclusion on evolution, I have read quite a bit and I find that writers in general are like your readers: some refrain from discussing the subject at all, others try to prove that it is an impossibility, and some accept it and try to work it in with their other ideas and beliefs. Apparently, the main reason most people dislike the idea is because of their religion. Personally I think that religion and evolution are very closely related. A study of the matter seems to show that even our present day religions have come about by an evolutionary process. Evolution is a principle accepted by the majority, religious or non-religious. As far as I know no other acceptable explanation has been given for the races of mankind. Religion is not against evolution. It is a known fact that there has been evolution. Who can say just how much or how little change has actually occurred? And what good does it do to argue on points about which we are uncertain? I think Edison had about as beautiful a religion as anyone and a more beautiful religion than most people and speaking of religion, he said, "Pile up the evidence and make it the sort of evidence which no one can demolish." That's what the scientists of today are doing and that's what the religious leaders of today ought to be doing.—R.G.F., Bedford, Ia.



There's Energy Here But What Is Its Source?

WILL some of your readers help me solve this problem? The law of the conservation of energy states that energy cannot be created. Now if a permanent magnet is made by bringing it into contact with an electro-magnet, the number of foot pounds of energy put into the magnet can be calculated if the watt seconds are noted. When the magnet is finished, it will lift small pieces of iron against the force of gravity for an indefinite period. Here again we can calculate the foot pounds of work done if we know the weight of the iron and the distance it was lifted. If we multiply this by the number of times the iron was lifted, the energy expended by the magnet will be greater than that put into it, provided we lifted the iron



a sufficient number of times. If the energy is not created by the magnet, where does it come from? Won't one of your physicist readers please enlighten me on this baffling subject?—G.C., Beecher, Ill.

Near the Bursting Point, He Has to Tell His Ideas

As the result of many hours of tremendous mental effort, I have reached various conclusions. And if I don't tell some one about them at once, I'll bust! First, ether, radio, and light waves do not extend indefinitely throughout space. Furthermore, ether is actually something. It is the fourth state of matter. It is matter that has collapsed because of a lack of both electronic and molecular motion. It surrounds all astral bodies and permeates all other states of matter. It is displaced only by the fundamental units of all matter, electrons and protons. Radio, heat, infrared, visible, ultra-violet, X-rays, and other waves are all the same thing—electrons in motion. When a stream of electrons moves through space, it displaces ether just as a stream of cars, moving at regular intervals, displaces air. I could keep this up for days and days and days, but it just occurred to me that perhaps I might be boring you. However, even if you don't like my theories, it's a relief to tell somebody about them.—W.W.A., New York, N. Y.

QUICK, BEFORE YOU BUST!



Crossbow for Measuring Stars Pleases Him

IN MAKING the crossbow as described in your article on astronomy, I did not use a string or wire at all as I concluded that the vital part of the bow was in having each point of the arc twenty-eight and one-half inches from the eye. So in place of the string, I made, out of thick plywood, a cut-out frame that works beautifully. The plumb line is bent around the arc. You were perfectly right in the measurement given in your article, for it works out exactly when drawn on a drawing board. The frame holds the arc rigid and it is light. I followed the approach of Jupiter and Mars and it was most interesting. I have been interested in such things for many years and have an excellent three-inch telescope with both equatorial and altazimuth mountings. I am a member of the Maryland Academy of Sciences and we have a fine eight-inch Clark glass with which to study the stars.—T.R.H., Baltimore, Md.

This Private Fight Now Open to the Public

I SHOULD like your readers to settle a problem that has been nearly fought over by a friend and myself: Given a turning airplane propeller that is slowly but constantly gaining in revolutions per minute. Is it not true that when a certain number of revolutions is reached, the peak of the propeller's efficiency will be attained and thereafter efficiency will be lost? An early answer will save nervous wear and tear. Like C.J.S., in a recent issue, I should like to get the directions for constructing this a microscope. Like many other readers, I should like to see something more advanced in the chemistry articles which are fine as far as they go.—W.B., Cimarron, Kans.



Niagara Falls Started Out As a Series of Rapids

IN ANSWER to J.W.C., David City, Nebr. He failed to make his calculation of Niagara Falls up-river travel, from the glacial period, during which the terrane of that section was completely altered. In all probability, Niagara Falls originated at the lower end of the present gorge and for thousands of years the total descent was nothing but a series of rapids with no single large fall to threaten the extinction of Lake Erie. As to the ice-heavy South Polar Continent turning the world upside down, the writer fails to state which way is down, from there. In fact the total amount of ice at the South Pole does not materially change from year to year. I agree with the writer's suggestion that there may be advanced forms of life on other planets and if they signal us the signals go unheeded because of our dumbness.—J.N.F., Storrs, Conn.

Model Railway Scenery Made of Fly Screening

IN ANSWER to A.W.'s query regarding what to use for scenery in his model railway, I should like to tell him what my uncle used in a similar case. His railway was mounted on a large table with a hole cut in the middle, so that he could reach every part of it. One end, flush with the table top, represented a city or town and the corresponding railroad terminal. At the other end, he had constructed two levels of framework covered by ordinary fly screening painted white to represent the snow of mountains. The lower framework was used for trains that went through tunnels on the side of the mountain. The upper tier had upon it a little mountain village and station. The screening was bent to form undulations in the side of the mountain, and houses and trees could be very easily placed upon it. My uncle used tiny toy houses, of course, with little lights in them, making the whole scene seem remarkably realistic. This screening did the trick perfectly, for it was cheap, sturdy, could be cut and molded easily, and never needed repair.—P.S., Watertown, Conn.

SO THAT'S HOW ALL THE FLIES GOT IN THE HOUSE!



Disappointing Conduct Of Those Frost Feathers

I SUPPOSE 10,000 mountain climbers will write you and no doubt some scientists will also set you right. But at the risk of triplication, I must draw the attention of C.P.S., of Coldwater, to the fact that frost feathers form into the wind, not "behind the post." Ask the scientist for the rest of the explanation.—M.H., Cambridge, Mass.

Snags He Has Struck In the Einstein Theory

I WANT to submit to your readers some ideas that seem to me to refute the conclusion of Einstein's theory. Einstein says that the universe is probably finite in time and extent. If that is so, then what is beyond in both time and extent? Even if beams of light bend from the straight line on which they must start from their source, what do they do when the next nearer body which they pass is on an opposite side of that theoretical straight line? Some believers in Einstein say that the universe, like the earth, may be finite but unbounded. But is not the earth entirely bounded by space? As to Professor Jeans' expanding universe, what do we yet know of the what, how, why, or anything, of the

government and regulations of the cosmos as a whole, or for that matter, in part even?—F.L.J., New York, N. Y.

It May Be Your Light Just Simply Ceases to Be

I HAVE been studying the problem of light and as a result have several strange ideas stirring inside my head. One of them has to do with the question of where the light goes after it has disappeared. I have read many articles on light but have not found an answer to this question and so have been tempted to answer it for myself in this way: After the source of the light has been turned on, luminiferous particles in the ether become instantly red hot and produce an effect on the retina. When the source is turned off, these luminiferous particles quickly cool, just as a red-hot needle does when taken out of a flame. I hope my idea merits scientific consideration. If I am wrong, I should be glad to receive a more explicit explanation of this phenomenon.—J.K.G., Tallahassee, Fla.

OW! J.K.G. MUST BE RIGHT



Make Two Trees Grow Where Only One Grew

AFTER spending several sleepless nights figuring out a couple of your latest Readers Say problems I thought I'd get back at the birds who sent 'em in by sending in a twister of my own. It seems a farmer had ten small trees to plant. Being a contrary cuss and a Scotchman as well, he decided to arrange them in five rows of four trees each. How'd he do it? I know, five times four equals twenty, but it's possible as you will discover if you sit down and figure it out.—J.D.C., Cincinnati, Ohio.

Refuses to Take Earth As a Younger Brother

IT WAS news to me that the earth is young by comparison with other planets, as was stated by a recent writer in this department. The Chamberlin-Moulton and Jeans hypotheses both advance the theory that planetesimals (from which all the planets formed) were drawn out from the sun by the tidal effect of a passing star, perhaps aided by eruption on the sun's surface. Furthermore, I understand that it is still a matter of doubt that elementary life, as we know it, could exist on any of the other planets, to say nothing of a form higher than any we know.—A.F.F., Hanover, N. H.

If the Flying Boiler Explodes, That's Just Too Bad

THIS new steam airplane that flew out in California recently is supposed to be pretty safe because it burns oil instead of gasoline. I can see how that would keep it from catching fire in case of a crash. But how about the boiler cracking up?





QUALITY TELLS...

*MORE AC SPARK PLUGS
ARE USED BY CAR BUILDERS
TODAY THAN ALL OTHER MAKES
OF PLUGS*

Combined

NOTHING can take the place of quality. It overshadows all else. It holds the spotlight of public favor.

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AC SPARK PLUG CO.

FLINT, MICHIGAN ★ ST. CATHARINES, ONTARIO

POPULAR SCIENCE MONTHLY



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RAYMOND J. BROWN, Editor

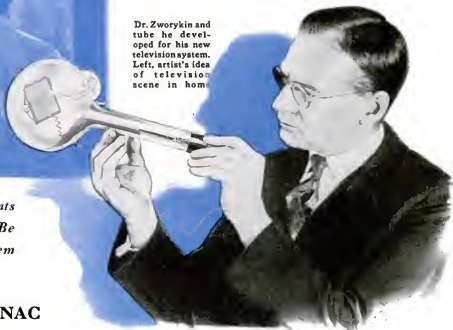
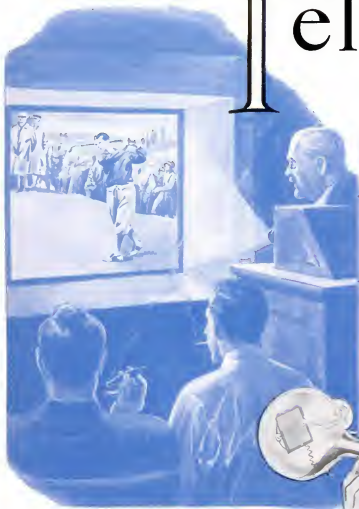


"Human-Eye" Camera OPENS NEW WAY TO Television

ENGINEERS in a Camden, N. J., laboratory, the other day, examined a mysterious little black box on a tripod. A lens protruding from the turretlike top gave it the appearance of a camera, but such a camera as never before had been built. Ten years of intensive research had achieved, in this instrument, man's nearest mechanical approach to the human eye.

Called the "iconoscope," meaning "image observer," by its inventor, Dr. Vladimir K. Zworykin, the new instrument is said to remove the last serious obstacles to practical television. Batteries of the television eyes are likely to take their places alongside the microphones of radio announcers at sports events and at the scenes of important public ceremonies. The actual scene, as well as the sounds, will be put on the air. Sitting in his home before a television receiver of simple, inexpensive design, the broadcast fan will see a news

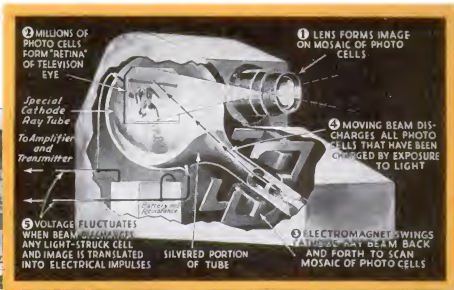
Dr. Zworykin and tube he developed for his new television system. Left, artist's idea of television scene in home



*Views in Your Home of News Events
and Historical Gatherings May Be
Possible with New Broadcast System*

By
ALDEN P. ARMAGNAC

Transmitting the Picture



This simplified diagram shows the manner in which the television eye works. Sketch at left suggests how television cameraman will cover sport events. Diagram below shows construction of the artificial retina for the new eye.

event that is taking place miles away.

Predictions like this have been made before; now, at last, they seem about to be realized. The scientific part of the work is done and only the commercial and financial problems of television remain to be worked out, Dr. Zworykin declares. His mechanical eye solves the problems that have kept television in the experimental stage. Any one of the iconoscope's three most noteworthy features would, alone, be reckoned an outstanding advance in television.

Most obvious, from a glance at the new instrument, is its portability. Compact and light enough to be slung over the shoulder like a movie camera, it is easily carried to the scene of action.

Second, because of the iconoscope's sensitivity to light, television will no longer be restricted to the studio, under glaring lights; outdoor scenes also can be put on the air.

Lastly, the iconoscope is a television eye without a single mechanical moving part. There are no whirling disks or humming motors, and therefore there is virtually no limit to the speed at which the robot eye can take in a scene.

Strangely enough, all these gains have been secured by a return to first ideas of

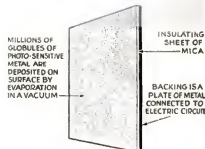
television, which are worth recalling in order to understand the latest invention.

The one problem in television is to put a picture into a transmitter, and get it out again at a distant receiver virtually instantaneously. Invention of the selenium cell and later of the more sensitive photo-electric cell provided the tools to make this possible. These cells have the power of turning light into electrical impulses for transmission by wire or radio.

Using these cells, each part of a picture could be transformed into a strong or weak electrical impulse, depending on whether it was light or dark; the impulses could be transmitted instantly to the receiving end; and there transformed back into light and used to build up the picture again.

The simplest way to do this would be to project the picture on a checkerboard of photo-electric cells grouped closely together, and transmit all their impulses at once to corresponding electric lamps or shutters in a similar checkerboard arrangement behind a receiving screen. In this way two Frenchmen, as long ago as 1906, succeeded in transmitting simple patterns with a bank of sixty-four photo-electric cells, each one connected by a pair of wires to a shutter in the receiver.

To obtain a clear picture with sharp detail, it is necessary to reproduce, individually, the lightness or darkness of at least 70,000 different parts or picture elements of the original image. Obviously, it would be impossible to transmit so many impulses simultaneously, since it would require 140,000 wires from the transmitter to every receiver. Hence arose the alternative scheme: to explore or "scan" the picture and transmit its parts one by one instead of all at once.



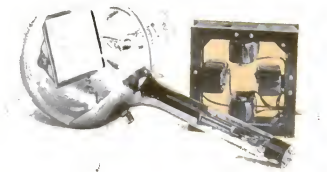
This would require only one wire or radio channel.

Virtually all recent television experiments have been based on this principle. By any one of a variety of means, such as whirling disks studded with lenses or pierced with holes, each part of a scene in turn is momentarily allowed to register its lightness or darkness upon a single photo-electric cell, and the resulting series of electrical impulses is put on the air. At the receiving end, the impulses control the brightness of a spot of light that travels over a corresponding path on a receiving screen to re-build the picture. So rapidly is this done that the track of the light beam in the receiver fuses into a single complete image; and the process is repeated enough times a second to give moving pictures.

Recently television engineers struck a snag. Apparently no further improvement in picture quality, which would require them to run a transmitter faster in order to cover more individual points of a picture, was possible. They were already running their machines so fast that the photo-electric cells of their transmitters barely had time to respond as each part of the image whirled before them. As a result only studio television under glaring light was considered practical.

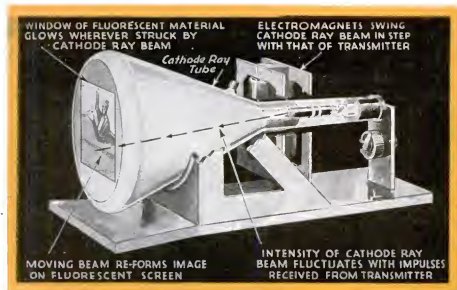
Where others had failed in this seemingly insuperable task, Dr. Zworykin, by throwing away current ideas and going back to first principles, succeeded. Working in the laboratories of the RCA Victor Company in Camden, N. J., he produced a mechanical eye that is a triumph of inventive genius.

Like the human eye, the iconoscope uses a lens to project an image of a scene upon



Closeup view of the new cathode ray tube and its artificial retina. In square, right, electromagnets that swing cathode beam across retina

Receiving the Picture



This diagram gives a clear idea of the operation of the home receiver, for use with the new television eye. The sketch at right shows how the scene, pictured on opposite page, will appear when received on home apparatus



an artificial retina, and this amazing retina is the key to the whole invention. Just as the human eye's retina is composed of innumerable rods and cones that respond to light, so Dr. Zworykin's artificial retina is a mosaic of millions of microscopic photo-electric cells. These cells are of light-sensitive metal, formed upon the front of a thin sheet of mica by evaporation of the metal in a vacuum. A metallic coating on the back of the insulating mica sheet, and a silverized portion of the eighteen-inch tube in which the retina is housed, serve as terminals for the electric circuit, which may be regarded as the optic nerve, since it transmits what the retina sees.

But how could the mechanical eye unscramble the impulses from these millions of cells? Some sort of scanning was necessary, and Dr. Zworykin found an entirely new way to do this. He housed his retina in a cathode ray tube, which hurls a narrow beam of electrons at the mosaic of photo cells. Taking advantage of the fact that a cathode beam can be deflected by magnets, Dr. Zworykin enclosed the tube in a yoke of four electromagnets that swing the beam back and forth across the retina at twenty miles a minute!

While this is happening, photo cells are electrically charged wherever they are exposed to light. The moment the moving cathode beam shines upon a light-struck cell, it discharges it of electricity as a trigger fires a gun. The result is a sudden fluctuation in the voltage of the electric circuit common to all the cells. In this way each of the millions of cells waits its turn to go on the air and report on the lightness or darkness of its sector of the picture. As a result the image is transformed into a stream of electrical impulses that can be put on the air by a radio transmitter.

So rapidly does this take place that the entire picture is scanned twenty times a second. In the waiting period before it goes on the air, each cell has time to acquire thousands of times as great a charge as in other systems; it is constantly watching the picture, instead of blinking at it. Hence the new iconoscope is able to work outdoors and indoors in light that would have been considered impossible for television a few

days ago; in fact, in any light where an ordinary camera could take pictures. If you were first to hear the explanation of this involved principle and then to see the instrument, you would be amazed at its compactness and the simplicity of its operation.

What type of television receiver will be designed for the home? Particularly adapted for use with the iconoscope is a receiver developed by Dr. Zworykin several years ago, and called the "kinescope." It employs a cathode-ray tube like that of the transmitter, except that the retina is replaced by a window of fluorescent material that glows wherever the cathode beam strikes it. Electromagnets swing this beam exactly in step with that of the transmitter. The intensity of the beam itself, meanwhile, is made to fluctuate by the radio impulses coming over the air. Thus the speeding beam retraces the image in highlights and shadows on the glowing window of the tube.

Sitting before the instrument, the owner will see a moving picture about four by five inches in size, which may be magnified if desired, and he will watch far-away events as if he were there in person.

From start to finish, in this system, there is no mechanical moving part. Even the pulsating currents that operate the electromagnets in transmitter and receiver are generated by vacuum tubes of special design. There is no reason why any television receiver of conventional design cannot also be adapted for use with the iconoscope, including the existing types that will project a picture large enough

for a theater screen. It is even possible to imagine a new kind of theater, entertaining its patrons with news flashes of world events happening at that very moment, instead of exhibiting newsreels made hours or days before.

Thus at one stroke the new invention brings television to the point where it may be ready, at last, for home and public entertainment. With that achieved, there will be time enough to develop other possibilities of the new mechanical eye in war and peace, industry and science—such possibilities as to set it at the eyepiece of a microscope more powerful than man has ever looked through, illuminated by invisible ultraviolet light, to reveal wonders hitherto seen only by photography. As with any other great invention, no one can foresee all the avenues to new marvels that it may open.



Here is the portable television camera and the amplifier used with it

Snakeskin *and* Marble

IN A WONDER workshop in New York City, industrial magicians are using the camera to transfer the beauty of costly things to objects that all can afford. Their wizardry turns cheap wood into handsome veneers for inlaid radio cabinets and furniture; asbestos board into tinted marble, and ordinary kidskin into snakeskin shoes. Made especially for POPULAR SCIENCE MONTHLY, the first photographs revealing the process are reproduced on these pages.

One of the world's largest cameras is used. The original object is set up and photographed as in color-engraving; but the metal plates obtained from the negatives are employed to imprint the pattern, with colored dyes, on a sheet of film-coated paper. This serves as a matrix whose pattern can be indelibly transferred by heat and pressure to the raw material. So faithful to nature are the synthetic products that they fool the eye, and they are often more lasting than real ones. The many steps in the process are so rapidly carried out that the finished product is inexpensive.



Synthetic Inlaid Articles, Made by the Photographic Method



As the first step in creating a synthetic inlay, an expensive panel of wood is set up and photographed with one of the largest cameras in the world, one that takes a picture forty by forty inches in size. It is this picture that is used in later processes



From big negatives, like this, perfect in every detail, metal plates are made, one for each color that is to appear in the finished article. From these the pattern is printed on film-coated paper to make matrix

On this sheet of film-coated paper has been printed the big picture. It will serve as a matrix for the transfer of the pattern to cheap material



Made by Photography .



LIGHT, DYES, AND HIGH-PRESSURE PRESSES
TRANSFER BEAUTY TO INEXPENSIVE OBJECTS



From this press comes the sheet of film-coated paper that serves as a matrix in the press seen below. A snakeskin pattern is imprinted on this sheet

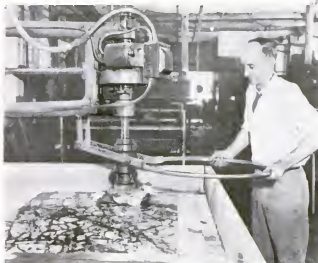
Imitation Snakeskin Manufactured of Kid



From the powerful press, at left, has just emerged this sheet of synthetic marble so faithfully copied that the eye is deceived. It is here receiving a spray of a resinous solution to prepare it for polishing. Veneers are treated in the same way



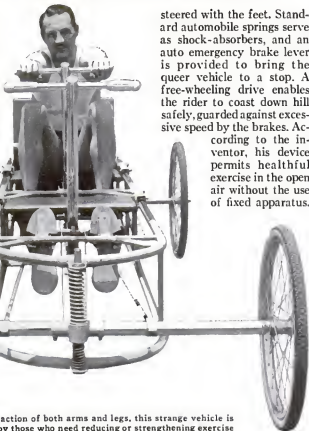
In this hydraulic press, where a high temperature is maintained, the actual transfer of the pattern to the raw material is made under a pressure so terrific that the imprint is permanently made. Picture shows asbestos changing to marble



A high gloss is given to the synthetic marble, left, with the polishing tool shown in use. As the last step of all in this process, an abrasive wheel, above, is used to trim the finished article. In this picture the asbestos foundation of the product is plainly visible

PUSH-PULL CAR REDUCES WEIGHT

AS AN AID in exercising and reducing, a Los Angeles, Calif., inventor has designed the unusual vehicle pictured here. Its occupant sits on a sliding seat, patterned after those of racing shells, and propels the handcar by pushing and pulling on handles in front of him. The car is



Propelled by the action of both arms and legs, this strange vehicle is designed for use by those who need reducing or strengthening exercise

steered with the feet. Standard automobile springs serve as shock-absorbers, and an auto emergency brake lever is provided to bring the queer vehicle to a stop. A free-wheeling drive enables the rider to coast down hill safely, guarded against excessive speed by the brakes. According to the inventor, his device permits healthful exercise in the open air without the use of fixed apparatus.



WORDS ON DISK TEACH FOREIGN LANGUAGE

STUDENTS and travelers may find the intricacies of a foreign tongue less trying through the use of a "verb wheel" invented by a University of Colorado professor. Adapting a principle used in other informational devices, the self-instructor comprises an upper disk with windows, and a lower disk on which are printed the most commonly used verbs of a given language, together with their forms in the various tenses. By spinning the top disk to any verb, as shown above, the user may read through the proper window its form in the tense he desires. The disks are supplied for French, Spanish, German, and Latin verbs, and are made in two sizes—one seven inches in size for classroom use, and a five-inch size for travelers.



TRAFFIC POST VANISHES WHEN NOT IN USE

EASILY let down into a sunken well in the pavement, or raised into its exposed position, a disappearing traffic post of steel tubing devised by a California inventor, need not be carried to and from its site. When the post is lifted to its proper height of twenty-two inches, a spring catch holds it in place; to lower it, the post is first raised and turned slightly, releasing the catch so that it readily drops from sight. Red warning reflectors top the device.

SKI JUMPERS USE STRAW SLIDE

DRESSED in summer togs instead of winter costumes, noted ski jumpers gathered recently at Barton, Mich., to try out one of the world's strangest slides, which is expected to make skiing a year-round sport. Tightly-packed straw, instead of snow, was heaped along the entire length of the course for the mid-summer meet. So little friction did it offer to wooden skis that contestants

were amazed at the speed they attained on gliding down the sloping runway. Leaps of more than seventy feet were recorded by some of the daring jumpers. The striking photograph, reproduced below, shows Johanna Kolstad, woman champion of Norway, sailing through the air from the straw-covered take-off for a sixty-five-foot jump that ends on packed straw.



Sliding down a long incline, covered with packed straw, this ski enthusiast is just taking off for a sixty-five-foot jump. With the use of straw it is believed skiing can be made a summer sport

Irrigation Aircraft Also Can Be Used to Fight Fires from Air

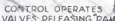
Irrigation Aircraft Also Can Be Used to Fight Fires from Air



*Fighting
Fire from
the Air*



HOW PLANE SCOOPS UP WATER FROM RIVER OR LAKE



WATER FLOWS UP
INTAKES DURING
LOADING

QUICK-DUMPING VALVE
IN WATER INTAKE IS
OPENED WHEN DIVING
AT FIRE

ANK

SPRAY NOZZLES

RAIN
FALLING FROM AIRPLANE
WATERS FIELD

SCOOPS FOLD
ON PIVOTS
FOR LANDING

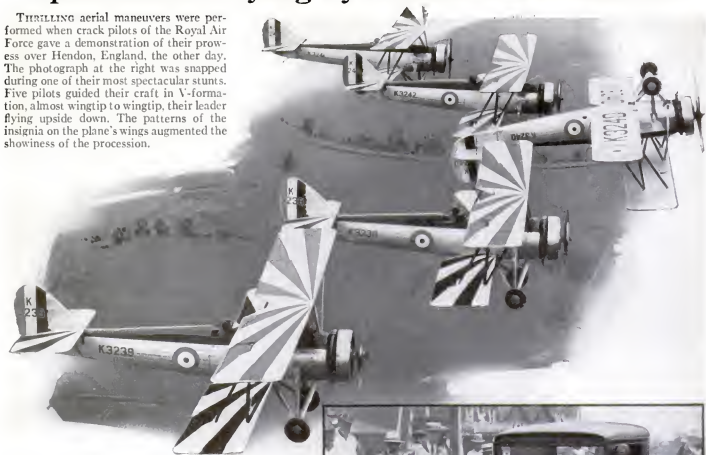
Irrigating a Field

FAVORED by chance, a lucky cameraman snapped the remarkable view of the tidal bore on the River Severn, in England, reproduced at the right. This strange phenomenon occurs at the change of the tide when the rising sea rushes into a funnel-shaped river mouth. The resulting wave may reach terrifying proportions, as in the twelve-foot bore of the Amazon River.



Spectacular Flying by Planes in Formation

THRILLING aerial maneuvers were performed when crack pilots of the Royal Air Force gave a demonstration of their prowess over Hendon, England, the other day. The photograph at the right was snapped during one of their most spectacular stunts. Five pilots guided their craft in V-formation, almost wingtip to wingtip, their leader flying upside down. The patterns of the insignia on the plane's wings augmented the showiness of the procession.

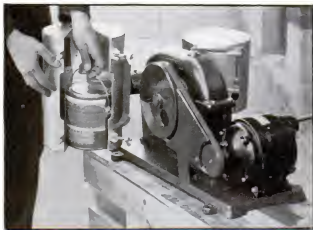


TRUCK FOR ROAD OR RAILS

INDEPENDENT of motor highways is an unusual auto truck that recently received its first public test at Verona, Pa. Whenever the driver wishes, he may leave the road and take to the rails of a convenient railway, provided the train dispatcher has no objections. Outwardly the truck resembles any other, save for a pair of small flanged wheels at front and rear, and an overgrown bumper topped by a hand wheel. When the truck is to be run along the railroad a few turns of the hand wheel suffice to lower the guide wheels and lock them into position just ahead of the front tires and behind the rear ones, as shown in the photograph at right. When withdrawn for driving along a highway, the guide wheels clear the ground by about four inches, thus giving sufficient road clearance.



ELECTRIC SHAKER RENEWS OLD PAINT



Paint grown worthless through long standing in cans is made good as new by being shaken in this electric-powered device

CANS of paint that have stood on shelves for as long as fifteen years are said to be made as good as fresh ones by an electrical joggler recently placed on the market. When a can is locked securely in a holder and the machine is plugged in at any light socket, the can is subjected to a rapid, continuous jarring that detaches the hardened pigment at the bottom and mixes it thoroughly with the oil. Restoring the paint to its original condition requires from three to seven minutes of rapid shaking in the new device.



TWO BULBS JOINED IN ONE LIGHT

DESIGNED with one bulb and reflector at the front, and a second bulb and reflector in the top, a new multi-purpose electric lantern

gives illumination to suit any need. The front lamp is a penetrating, 800-foot spotlight for picking out distant objects at night; the top one, a diffused floodlight that serves as a general utility light in the home, or, when set down beside a car, as a trouble lamp for motorists. A single switch turns on either the powerful spotlight or the broad floodlight as desired.

Model of a bridge built according to the new plan, shows its strength, as is seen below, by supporting 318 pounds



PLAN FOR LIGHTER BRIDGES OF WOOD



This new bridge across a river in Ohio, was built according to the new design, with an arch of many-ply construction, thus increasing its strength

A NEW way to build wooden bridges, worked out by an Ohio architect, promises economical structures of unusual strength and rigidity. The truss or arch of the bridge is of many-ply construction and is built up of alternate layers of compression, or thrust-carrying members, and of sheeting. These are nailed, glued, and bolted together, in as many layers as required by the weight to be carried. The resulting truss is so light that this type of bridge can be installed on old foundations that would not hold an ordinary modern structure.

PLANTS GROW UNDER ARTIFICIAL LIGHT

CONTRARY to the popular idea that household plants must be placed near windows to thrive, recent tests show that they grow well under artificial illumination. Relatively little electric light, General Electric engineers find, keeps begonias, tulips, geraniums, hyacinths, ferns, and many other plants in good condition. The lighting preferably should come from above the plants, since otherwise they bend toward it, in some cases touching it and being burned. The engineers are helping manufacturers of lighting equipment develop illuminated household stands especially for the purpose, using reflectors to economize on the size of lamp bulb required, although improvised lighting shows good results.



Fixture, above, has been developed for use in growing plants in the home by artificial light. An aluminum reflector under the shade increases light



Growing without benefit of sunlight, the hyacinth, left, is thriving in a flowerpot illuminated by a ten-watt bulb. A spike supports bulb and shield



RUBBER FERRULE MENDS GOLF CLUBS

QUICK repair for damaged string windings that secure the leather wrappings of golf club grips is offered by a newly introduced set of rubber ferrules. These are slipped upon the grip by means of a wooden applicator, as shown in the photograph above. They are then rolled over the windings and pushed out flat, forming a repair as illustrated in the drawing. Since the ferrules are weatherproof, they also offer protection to good windings.

USE ROLLER CHAIN TO COUPLE POWER SHAFTS



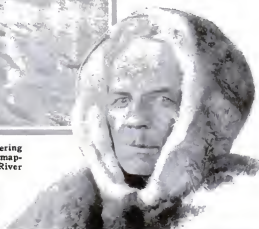
CONNECTION in the newest type of flexible coupler for power shafts is formed of a short length of roller chain. Two toothed sprockets, machined to a close fit for the chain and keyed to fit the shaft, form the two halves of the coupler. A pin-and-cotter link makes it an easy matter to couple or remove the locking chain as the work may require.

Queer Jobs in the Arctic



With this sail sled, two explorers traveled across the Bering Sea on their northern invasion made for the purpose of mapping a route for 3,000 reindeer from Alaska to Mackenzie River

Major L. T. Burwash, right, has the unusual task of finding the position of the North Magnetic Pole



*Finding
Magnetic Pole,
Moving
Reindeer Herd
All in Day's
Work for
Canada's
Explorers*

STUNG by frozen snow that is whirled along before a bitter-cold wind, half a dozen men, with dog teams, are helping to solve the Arctic problems of the Canadian government. The work of these men, one of the few government-paid groups of explorers in the world, takes them into vast, hitherto unexplored regions where for weeks at a time the temperature is forty below zero, and there is no human life.

Richard Finnie, a Canadian Government explorer, spent a year with an Eskimo tribe to learn their folk lore tales

make the trip. Another party braved the rigors of frozen sleeping bags to map the wanderings of the rare musk-ox, also sought for herding. A winter on the sea ice with an Eskimo tribe was the lot of one explorer, whose mission was to obtain a pictorial record of the daily life, dances, and folk lore in a seal camp.

One of the strangest assignments fell to Major L. T. Burwash, short, stocky, white-haired veteran of the Arctic, who goes out every now and then to find out where the North Magnetic Pole is. This shifting spot, to which the compass needles point, lies in the region of the bleak Boothia Peninsula. Fishing camps are the only signs of civilization in that frozen wilderness. On one trip, the explorer's food ran short. A cache of caribou meat was found covered with seven feet of ice through which he could not penetrate. A couple of boots, and some fur clothing, pieced out his scanty diet of cold rolled oats until, by rare good luck, he encountered a tribe of natives and was saved from starving to death.

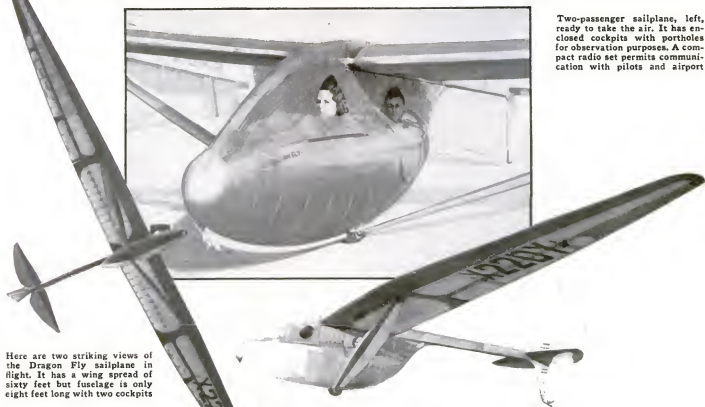


One of Burwash's dogs sniffs the frozen waste near the point at which the explorer found the Magnetic Pole



Vast herds of these musk oxen once roamed the frozen tundra of the Arctic Zone but few remain. Canada plans preserves to prevent their extinction

Two-Passenger Sailplane Has Closed Cockpits



Here are two striking views of the Dragon Fly sailplane in flight. It has a wing spread of sixty feet but fuselage is only eight feet long with two cockpits

CHRISTENED the "Dragon Fly," a new sailplane of ultra-modern construction has been designed and flown successfully by Hawley Bowlus, veteran glider pilot, at Glendale, Calif. The motorless two-seater craft is built of plywood and weighs only 360 pounds, de-

spite its huge wing spread of sixty feet. Pilot and passenger enter the enclosed cockpits through trapdoors, which are then closed by U-shaped lids. Portholes in the stubby fuselage serve as windows. A steering wheel works the

controls. In addition to an altimeter, an airspeed indicator, and a clock, the plane is equipped with a compact radio set with which the pilot can communicate with the airport and with the pilots of other craft. In one recent stunt, Bowlus' machine and two others were towed by an airplane,

Two-passenger sailplane, left, ready to take the air. It has enclosed cockpits with portholes for observation purposes. A compact radio set permits communication with pilots and airport



PORTABLE POWER PUMP

MOUNTED on a frame so it can be trundled about like a wheelbarrow, a new pump is always at hand when it is needed. A little gasoline motor operates it and can shoot a jet to surprising height. The photographs above show the pump being rolled to the job, and in action.

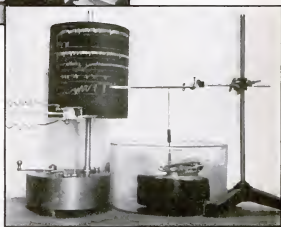
OYSTER'S QUIVERS NOW MEASURED



General view of oyster-testing laboratory. Right, oyster fastened to brick in jar so its quivers can be traced on chart by indicating arm

RECORDING the quivers of an oyster, with a device resembling a seismograph, was the recent odd task of two U. S. Bureau of Fisheries experimenters at Beaufort, N. C. Seeking to reduce the labor of shucking oysters—an important item, since fully sixty percent are shucked before marketing—they found that certain chemicals acted like anesthetics,

causing the oysters to open of their own accord. To test the comparative effect of different solutions, each of 200 oysters was immersed in chemical with one shell cemented to a brick and the other attached to the indicating arm. The resulting time charts showed the first tentative quivers and the final opening of the shell.



By Edwin Teale

Rare-Stamp THWARTED BY



The stamp above is a counterfeit, the one at the right is genuine. Examine them and you will note the differences. Under the microscope, the inaccuracies become instantly apparent.

Courtesy, George B. Sloane



IN THE palm of his hand, not long ago, an eastern dealer held two carmine and blue postage stamps. One was worth 50,000 times its weight in gold. The other was worth no more than a scrap of paper. Yet, even under a high-powered magnifying glass, he could detect no difference. Only rays of black light, coming from a quartz lamp in his laboratory, had disclosed an amazingly delicate operation performed by stamp surgeons of the underworld.

The original was a rare 1918 twenty-four-cent airmail stamp with an inverted center. Less than one hundredth the size of this page, it was worth \$3,300. An ordinary stamp of the issue, with center right-side-up, can be purchased for as little as a dollar and a quarter. Rare-stamp racketeers had bought two ordinary stamps and had combined them to produce a fake stamp with an inverted center.

First, they had cut out the blue vignette at the center of one stamp and scraped the back until the paper was only half its normal thickness. Then, cutting carefully around the center of the second stamp, they removed the top layer of the paper, leaving a flat-bottomed pit hardly $\frac{3}{1000}$ ths of an inch deep. Into it, they pasted upside-down the center that had been prepared, gluing it in place with special albumin paste made from the white of an egg. Such paste will not dissolve in water, and even if the stamp were boiled, the parts would hold together.

It was a seemingly perfect job. But the crooks overlooked one thing. This is the latest scientific aid to fraud detection, the ultra-violet lamp. Under its invisible rays, the fine line of albumin around the center of the stamp stood out in brilliant contrast to the paper and exposed the plot.

In recent years, the hobby of stamp collecting, which grips kings and clerks alike, has boosted the price of bits of colored paper to fabulous sums. Million-dollar collections are in existence and a few stamps are literally worth fortunes.

Consequently, it is not surprising that stamp forgers and stamp fakery are on the increase. When I recently spent an afternoon at the auction room of George B. Sloane, famous New York dealer and official expert for the American Philatelic Society, he told me that members send him upwards of 2,000 precious stamps a year for examination. Another expert estimated that at least 20,000 bogus, counterfeit, or faked stamps have been put upon the market at one time or another.

To separate these "album weeds" from the genuine stamps, the experts employ an array of scientific helpers. They are aided in their work by millimeter scales, ether tanks, color-sensitive plates, perforation gages, ultra-violet ray machines, chemist's tubes, and microscopes. And the discoveries they make not only protect the collector but also break up gangs seeking to defraud the government by counterfeiting current issues.

In two cases when underworld gangs sought to flood the country with worthless stamps, collectors were the first to detect them. Again, when crooks in the South, not long ago, tried to wash off cancellation marks with chemicals, re-gum the backs of used stamps and sell them for new, they had operated for less than two weeks when a collector spied one of the doctored stamps and notified the government.

A recent dispatch from the west coast tells of the rounding up of another gang engaged in selling used stamps reclaimed under peculiar circumstances. The stamps, obtained from used parcel post wrappings, had been coated with shellac when they were pasted in place to keep them from being rubbed off in transit. Consequently, the cancellation marks at the post office had been imprinted on the film of shellac rather than on the face of the stamps and it was an easy matter for the criminals to wash off the shellac, re-gum the stamps and



TESTS FOR COUNTERFEIT STAMPS. A common error of the stamp counterfeiter is failure to reproduce exactly the number of perforations along the edges. The gage being used above reveals such variations. In center, comparing stamps under ultra-violet light

Racketeers

BLACK LIGHT

sell them for new. In all such cases, the spurious stamps are represented as having been sent in for payment for mail order goods and they are usually offered at \$115 worth for \$100.

In another recent case, a postal clerk in an eastern state was caught defrauding the government by an ingenious substitution of stamps. He worked in the parcel-post window. When a customer came in with a large package, he would take the money and lay aside the package until the customer was gone. Then, he would paste on used stamps, recancelling them with great pressure and sufficient ink to blot out all previous postmarks!

He, like the others, was tripped up by the alertness of a stamp expert. It is no wonder that an adage of the Post Office Department has it: "A wide-awake collector is the best of postal detectives."

But, it is not in this field that the most spectacular feats of the experts are found. It is in the realm of big-game hunting, of detecting fake stamps of rare and precious issues. Here, the clues they work on are often tiny errors, too small for the naked eye to see.

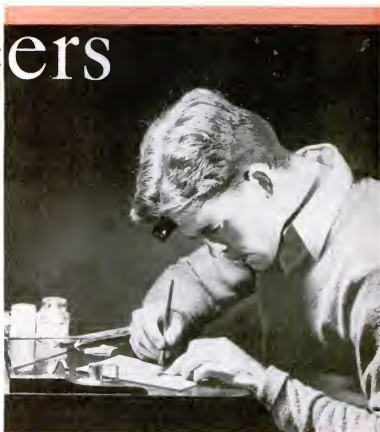
In one case, the picture of a lotus flower on a counterfeit Japanese stamp had one microscopic petal missing. In another instance, an expert enlarged two stamps to fifty times their size and discovered that an "o" in the genuine stamp leaned slightly to the right; in the counterfeit, slightly to the left! Again, in two almost perfect reproductions of American issues, one showed an added wrinkle in the stock around Benjamin Franklin's neck, and the other, now known as the "Sleepy Washington Stamp," portrayed the Father of His Country with a drowsy instead of an alert look in his eyes. It is through such tiny and curious minor differences that fraudulent stamp plots are often revealed.

PROBABLY the most remarkable plot of the kind was the \$65,000 Hawaiian "Missionary Stamp" case which came to a climax a few years ago on the Pacific coast.

The original stamps were printed in 1851 in Honolulu. Because they were used largely by missionaries to send letters back home, they got to be known as "missionary stamps" and these stamps are among the rarest known. An unused two-cent "missionary" sells for \$12,000; a used one for \$10,000. A number of years ago, two of the precious \$10,000 stamps were found by accident pasted to the wall of an old Hawaiian schoolroom. The whitewash cracked off and revealed an ancient letter attached to the boards beneath.

For more than twenty years, rumors had drifted through the stamp world that a number of unused missionaries had been brought back from the South Seas in the chest of a Cohasset, Mass., whaling captain. Taking advantage of this rumor, California counterfeiters worked up an apparently foolproof plot. According to their story, a missionary who was in the Hawaiian Islands in the eighteen-fifties had bought an even dollar's worth of stamps and had put them for safe-keeping in a psalm book. Shortly afterwards, he had died and the psalm book, together with his other belongings, had been brought back to America by a whaling captain from Cohasset and turned over to the missionary's son. On his death, the stamps were discovered.

Although no direct check could be made upon the story because the missionary, his son, and the captain were all dead, an investigation showed that all three had lived when and where the plotters said they had. On the



RACKETEER AND HIS TOOLS. The upper picture shows how the maker of fake stamps goes about reproducing rare issues. Beneath is his outfit of tools which includes perforating rollers, and dies and press with which he prints imitations of the stamps themselves and of cancellation marks



With this glass gage, bearing fine concentric circles, lines and spacing on suspected stamps are measured with absolute accuracy. In this way, fakes are found by the experts



To determine if the watermark on a stamp is genuine, it is dipped in benzene which helps the microscope reveal cuts incident to a fake

strength of this, an eastern dealer paid \$65,000 for the stamps. Only after he had returned East and was able to give them a thorough examination, did he discover they were cunningly executed forgeries. Minute differences, visible under high magnification, showed they were produced by photo-engraving while the originals were printed from type in the plant of a Honolulu newspaper. This discovery gave away the plot and resulted in judgment being rendered against the seller.

ALMOST always, Sloane explained to me, fake-stamp plots are worked out so ingeniously that the buyer is caught off his guard. Take, for instance, the clever ruse of one European forger.

He would advertise in stamp magazines under an assumed name, offering high prices for certain rare stamps which he was sure no dealer had on hand. Then he would counterfeit the stamps and, under a different name, write in to dealers setting a price far below the one in the advertisement. Anticipating a quick sale at a big profit, the dealers would snap at the bait and the crook would dispose of his counterfeits and disappear.

Another faker would print up what appeared to be a newspaper clipping announcing his death when things got too hot for him and would mail it to the stamp publications. They would reprint the announcement and he would move to another part of the country and start over again under another name. When the police again got on his trail, he would send in another clipping announcing his death under his new name and repeat the performance. He did this three times before he was caught.

The counterfeiting of stamps goes back

George B. Sloane, New York rare-stamp expert, is seen here comparing under a powerful magnifying glass a genuine stamp with one that may be a counterfeit. This examination, if it reveals no faults, will be supplemented with a black-light test and perforation gage



Placed side by side, it is not difficult to find differences in these stamps. The expert knows that one is a fake

Courtesy George B. Sloane

more than ninety years to the days of the "Black Penny," the world's first adhesive postage stamp issued by Sir Rowland Hill, in England. On the stroke of midnight May 5, 1840, the first black penny stamp was issued in Birmingham. A few weeks later, the first counterfeit appeared in London. However, it was so poor that it fooled few people. One of these early black stamps appears to carry on its face evidence it is a counterfeit; but it isn't. It is postmarked: "Bath May 2, 1840," four days before the first stamp of the issue was put in official circulation. The explanation lies in the fact that a government employee sent one of the stamps to a relative and the latter used it before the service was officially opened.

ANOTHER classic example of a rare stamp which was at first thought to be a counterfeit is the famous 1855 three-skilling-banco Swedish stamp printed in yellow. It first came to light when a schoolboy showed a dealer some stamps he had found in an attic. The expert thought the yellow stamp must be a fake because no specimens of that issue in that color had ever been seen. Investigation proved it was genuine, a government printer having used yellow instead of green ink by mistake. As a result, this bit of paper, which was originally worth a cent and a half, sold in Stockholm not long ago for \$10,000!

But the prize oddity of the stamp world

is a small British specimen. It was issued by a postmaster in New Brunswick who printed the stamp with the picture of Queen Victoria replaced by a picture of himself!

In determining which stamp is counterfeit and which is real, the expert must study the ink, the paper, the perforations, the glue—every minute detail. His hunting ground for clues is often less than one square inch of paper.

On a number of occasions, the texture of the glue, or gum, has been the telltale, deciding factor in the test. The original mucilage placed on the backs of stamps is made from vegetable matter. Occasionally, plotters will make the slip of using gum arabic or other glue in re-coating the backs of doctored stamps. Knowing the color, texture, and chemical composition of the gum used on different issues, the expert is quick to detect such frauds.

AGAIN, there are the watermarks which appear in the paper of some stamps. Crooks often counterfeit these by pressure. When such stamps are viewed from the back, they appear to possess the watermark. But when they are looked through, against a strong light, the illusion disappears. In studying watermarked specimens, the expert dips them in benzene, gasoline, or ether. This does not disturb the ink or gum on the stamp and it usually reveals every cut, tear or translucent watermark.

Stamp racketeers recently developed a new method of producing fake watermarks. They carefully scrape away fibers on the back of the stamp to form a translucent design which, in benzene or against a strong light looks like a real watermark. Experts, though, can detect this ruse with a high-powered microscope, which reveals a fuzz wherever the fibers have been scraped.

In a similar manner, microscopes help the experts to discover fake perforations. In some issues, the stamps are printed in sheets with the outer edges cut straight. Thus the outer stamps have one side, and the corners stamp two sides, which are unperforated. As collectors desire "well-centered" stamps with perforations on all sides, such specimens are worth less than the other stamps. (Continued on page 93)

Human Body Gets Machine Tests

JUST as they might keep performance charts of a steam engine or gasoline motor, engineers are now studying the human body, an engine far more efficient at turning fuel into work than any other known. At the Kaiser Wilhelm Institute, in Germany, subjects work in a miniature mine, operate sewing machines and compressed-air hammers, drive make-believe cars and walk treadmills, while electric contacts record their movements, and their diet and respiration are chemically analyzed. The data obtained will lead to improved factory design and management.

TESTING A STAIRWAY

To determine the best design for stairways, so as to make them easy to climb, the subject's breath is analyzed on ascents of various stairs at different grades



WORK OF THE HEART

Heartbeats are made audible by the electric machine shown above. Changes in heart sounds, as man's position is shifted, aid in diagnosing cases of fatigue

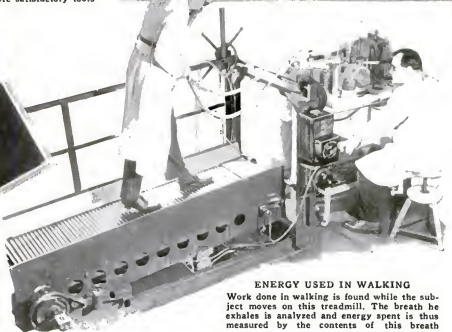
MINIATURE MINE

Electrical contacts record movements while the man works in this laboratory mine. The tests aid in designing more satisfactory tools



NERVOUS CONCENTRATION IS MEASURED

In this test of the human machine, a make-believe car is driven along the waving line. In this way, one's ability to react quickly, and to do a job requiring concentration, is accurately determined, as nervous-reaction record is made



ENERGY USED IN WALKING

Work done in walking is found while the subject moves on this treadmill. The breath he exhales is analyzed and energy spent is thus measured by the contents of this breath

• Freak Vehicles



The Cynosphere, an 1880 inventor's idea of an automobile. Each of the two rear wheels contained a large dog. These propelled the vehicle forward by running on a track in the wheels, exactly as a squirrel whirrs a ball inside its cage.



Eagles and vultures, wearing corsets, were to steer this fantastic dirigible airship. The birds were attached to a movable framework. By turning this, the ship would be piloted up, down, right, or left.

RIDING to the North Pole pulled by a kite! Crossing the Sahara in a juggernaut with fifty-foot wheels! Galloping along the ground on a mechanical horse with steel-pipe legs! Rolling over trees and houses in a 115-foot canvas ball blown by the wind like a tumbleweed!

Such are the curious, fantastic forms of conveyance inventors have proposed in the long search for swifter travel. Digging into the files of old newspapers and patents, you find a fascinating record of the inventive mind grappling with the problems of increasing human comfort and speed. It is a chronicle of queer ideas, of freak vehicles, of oddities of transportation.

Only a few weeks ago, a California inventor added to this list by obtaining a patent upon a water craft designed to roll across the surface of the sea.

His ship (see this month's cover) is a gigantic ball of metal with a streamlined passenger cabin trailing high behind on a Y-shaped arm of steel. Heavy Diesel-electric engines inside the ball roll it forward through the water by running up the side on an endless track like a squirrel in a cage. Fins, jutting around the tread of the ball, grip the water and aerial propellers at either end of the axle steer the craft to left or right. Passageways, running through the hollow supporting arm and axle, connect the cabin and the interior of the ball, while a gyroscope holds the craft erect upon the water. The inventor expects his vessel to be used for amusement-park purposes and in addition be valuable for transport work.

Ships designed to roll like wheels across the surface of the water have been proposed by many men. A quarter of a century ago, one, nicknamed the "Steel Log Steamer", was built and given a 200-mile test in Canada. The invention of a Toronto lawyer, it was a 110-foot hollow steel cylinder with



Filled with hydrogen, this huge canvas bag was a balloon; inflated with air, it was to be rolled along by the wind. The inventor actually rolled across Lake Michigan in it, but lost his life attempting to reach shore.

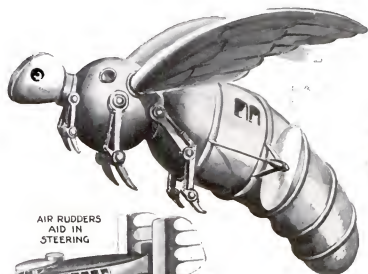


Here is the walking steam engine, built and tested in England about 1900. Note how the wheel treads resemble the feet of an elephant, making them suitable for travel on any kind of ground.

for Air, Land, and Water •

BIRDS, Dogs and Other Animals Used to Propel the Odd Boats, Wagons, and Airships Inventors Have Devised in Their Efforts to Bring About Faster, Safer, and More Certain Ways to Travel

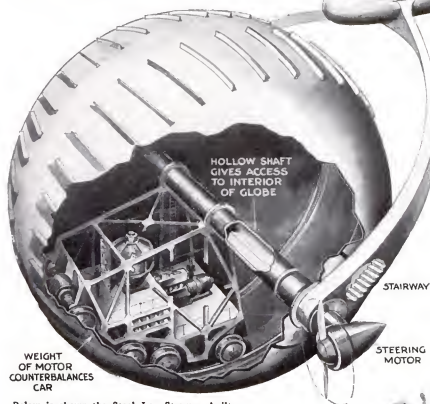
The rolling ball, below, recently patented, is designed to be driven on water by heavy engines inside running on an endless track. Steering is to be accomplished by motors at the sides, and passengers are to ride in the lofty cabin



AIR RUDDERS
AID IN
STEERING

WINGS HELP
SUPPORT CAR

A Belgian inventor produced this huge insect as his contribution to safe air travel. Flapping wings were to propel it and in landing it was to fall back on the telescoping air bag



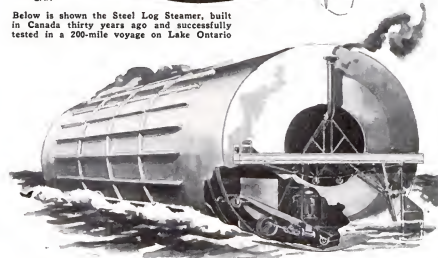
HOLLOW SHAFT
GIVES ACCESS
TO INTERIOR
OF GLOBE

STAIRWAY

STEERING
MOTOR

WEIGHT
OF MOTOR
COUNTERBALANCES
CAR

Below is shown the Steel Log Steamer, built in Canada thirty years ago and successfully tested in a 200-mile voyage on Lake Ontario



rudders at each end and a wide row of fins encircling the middle. Inside the cylinder, two small locomotives, one near either end, puffed away on endless tracks, running up the side to roll the freak craft broadside through the water.

It was completed in 1906. In a final test, it rolled from Toronto down Lake Ontario to the St. Lawrence River and down the river to Prescott, Canada, opposite Ogdensburg. With the engines going full tilt, the curious vessel attained a speed of six miles an hour. At the time, the inventor planned to construct a trans-Atlantic liner built on the same principle. It was to be 800 feet long and 200 feet in diameter. Sitting down with a pad and pencil, he calculated that if he could obtain only twenty-five revolutions a minute from this huge rolling log, he could attain trans-oceanic speeds of 200 miles an hour with his strange rolling craft.

While its speed was nothing to brag about, another application of squirrel cage power caused considerable comment in America fifty years ago.

A French engineer designed an apparatus called a Cynosphere. It was a tricycle with a small steering wheel in front and two large and curious wheels behind. Each of the rear wheels was shaped like a circular cage and contained a large dog. These "power-plants" rolled the carriage ahead by running squirrel-fashion on narrow tracks.

The operator sat in a sulky seat between the wheels and could throw the motors into "high" by exhibiting food or even a cat on special occasions. Whenever the dogs became tired, the engineer pointed out, the operator could change engines by replacing them with other animals. Patents on the idea were taken out both in France and the United States. The French Society for the Prevention of Cruelty to Animals was consulted and was said to have given its sanction to the plan. *(Continued on page 96)*

Cyclone Cellar Comes Ready to Use



This all-steel cyclone cellar has only to be sunk in a pit to make it a refuge against tornadoes. At right, drawing shows cellar's interior

AN ALL-STEEL storm cellar has been perfected and is now being marketed. It is considered an improvement over the typical cyclone cellars found in the tornado belt of the United States. It is shipped completely assembled and ready to install. No tools are needed except a pick and shovel to dig a hole for it. The entrance door and two ventilators project above the ground. The ventilators are screened to keep out insects. A steel stairway leads from the entrance to the pit floor, and seats along each side provide room, in an emergency, for twelve adults.

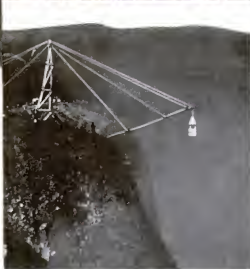


DESCENDS VOLCANO IN SEALED CAGE



Preparing to descend an active volcano, the Japanese explorer dons an oxygen mask. Right, cage used by explorer

WHEN a daring Japanese was lowered a quarter of a mile down into the crater of the active volcano Mihara, near Tokyo, the other day, and returned alive, his success crowned a carefully prepared venture to explore its interior. Live animals in special types of chambers had first been let down and drawn up successfully (P.S.M., Aug., '33, p. 15). For his own descent, the adventurer donned an oxygen mask and stepped into the sealed cage prepared for him. It was lowered from a boom overhanging the crater rim, until it was lost to view. When hauled back, the occupant emerged unscathed.



Here the cage of the volcano explorer is seen as it emerges at the conclusion of the adventure



BALSA-WOOD SAILBOAT FOR NEW BEACH SPORT

SURF-SAILING, a thrilling new sport for those who go to the seashore, is made possible by the invention of a new portable sailboat, resembling a life raft with a mast. Made of balsa wood, lighter than cork, it is an adaptation of the craft used by natives of Ecuador. Because of its light weight, the boat may be carried to and from the beach at the pleasure of its owner; and is easy to drag ashore or to launch. It is so buoyant that the lightest breeze moves it. The photograph above shows one of the new craft out for a sail.

LEANING TOWER OF PISA REBUILT IN CITY PARK

NEARING completion in a park near Chicago, Ill., is a half-scale copy of the famous Leaning Tower of Pisa, in Italy. The original 179-foot marble tower tipped because of faulty foundations, but engineers provided solid ones for the model, and built it of concrete. Except for this, the copy is accurate in every detail. When it is finished, a modern, electrically-operated set of chimes will be installed in the top of the campanile and regularly sounded.



Famous leaning tower of Pisa is copied accurately for a public park near Chicago, Ill.

SOUND TRUCK HELPS LAND AIRSHIP

WHEN the Navy's new airship *Macon* takes off or lands at the Akron Municipal Airport, Ohio, activities of the ground crew are directed by means of a sound truck that amplifies the voice of the moor-

ing officer so it is audible to every man on the handling lines. This system was particularly valuable during early practice flights, when a slight hitch in carrying out commands might have proved disastrous.



The photographic duplicator is shown in use, right. With it a letter is photographed on sensitized paper in fraction of a second



The copies made by the duplicator go to this portable darkroom for developing. Note the light-proof wristlet for hands

LETTERS COPIED AT HIGH SPEED

COPIES are speedily made of correspondence and other business records with the aid of a new photographic duplicating machine. Through its use, a letter may be photographed directly upon a sheet of specially sensitized paper, requiring an ex-

posure of only a fraction of a second, and developed at once in a portable darkroom. The instrument is especially designed for libraries, banks, insurance companies, and others requiring frequent duplication of card records and correspondence.



GERMANY'S NEWEST AUTO IS COMPLETELY STREAMLINED

FULLY streamlined, Germany's latest tear-drop automobile is fitted with disappearing headlights. To diminish air resistance, they are mounted in recesses in the mudguards. During the daytime, the headlight portholes can be covered with metal plates, hiding them from view and increasing the streamlined effect. The photograph at left shows one covered and the other open. The doors have no handles, a key being required to open them.



HISTORY TAUGHT WITH SILHOUETTE CUT-OUTS

HISTORICAL facts are entertainingly learned with the educational cut-out toy illustrated above. Detachable black pages bear on their reverse side an outline and on the front a printed legend. The result is a silhouette picture of an historical event complete with its story.

Animal Movie Actors

Trained by Strange Tricks



In the pictures, this dog doubles for a fox and here the trainer is seen putting fox skin on him

ON THE fringe of a California forest, a battery of movie cameras photographed a running fox. The frightened animal darted across a clearing and disappeared in the thickets. A half-hour later, with cameras set up on the same clearing from a slightly different angle, the fox dashed again from the trees on one side, ran across the cleared space, and plunged into the woods with dogs in hot pursuit. This process continued until several chase sequences were "in the can."

Then we moved into the woods just outside a country home. Cameras stared across the lawn. In reality we were on a large sound stage, with appropriately painted background to represent the forest through which we had passed the day before.

"All quiet, please," an assistant director cautioned. Then: "Okay. Camera. Turn the fox loose."

Across the make-believe grass flashed the fox. Like a brown streamer, his tail flowed astern as he bounded over the green carpet, leaped through a window, and disappeared into the house.

Next we moved to the interior of the room where the hero lost in thought stood beside the fireplace. Picture his astonishment when the wild fox flashed through the window, landed with a thump, and leaped into his arms for protection against the pack, which was seen through the window, leaping in a vain effort to reach their prey.

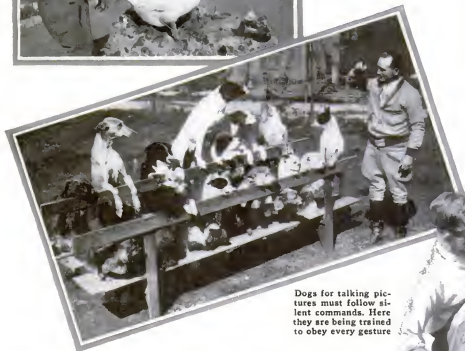
"Cut," commanded the director. "Wrap it up."

Here the movies have achieved the ultimate in animal training and deception. The fox had run from one forest to his cage hidden in another for the long shots, but the figure that jumped through the window was no wild animal. He was "Shorty," a mongrel dog. He looks so much like a fox that J. H. Kerr, his owner, decided six years ago to double him for a fox for closeups.

Kerr obtained a fox skin and a Los Angeles furrier tailored it so it could be slipped over the dog's body, covering all but his head and feet. A hookless fastener, pulled along his belly, inclosed him snugly in the skin. A



At left, a goose performing for the movies is induced to flap its wings by pulling the string tied to its leg



Dogs for talking pictures must follow silent commands. Here they are being trained to obey every gesture

TURNING AN EGGLE INTO A VULTURE

As vultures are hard to get, this eagle's head was clipped so it would look like a vulture when seen on the screen



In This Unusual Article, Movie Fans Learn How Dogs, Birds, and Even Skunks Are Put Through Their Stunts in Front of the Camera

By
Andrew R.
Boone



GESTURES GUIDE BUSTER

Standing outside the camera's line, the master makes motions and the trained dog responds quickly to each of the gestures

thimbleful of brown stain applied to his head and feet completed the deception. Shorty would look like a fox in anybody's picture at any distance.

He is one of two dogs, the only one to wear a fox skin, doubling for foxes in pictures. So expert is he in following Kerr's directions, in barking when told to bark, that he earns for his master \$35 for every working day, while the real fox, from an adjoining pen on Kerr's animal farm, draws only \$10 for his efforts.

Never before have I heard of a double earning a larger fee than the star!

On two dozen farms around the fringes of Los Angeles, many small animals undergo constant training for pictures. Some appear regularly, while others do their bits for the screen only once or twice a year. They command fees ranging from \$7.50 to \$75 a day, including the services of a trainer.

Even though a trained animal, be it skunk or dog, may rest for long periods between pictures, his owner will keep him

fit to appear on a moment's notice. Rennie Renfro works his sixty-three dogs daily to keep them in proper mental and physical condition. Long before the talkies burst upon the world, Renfro was training animals for pictures. During the days of silent cameras, he led them through intricate scenes by personally showing them the action, by talking to them constantly, by pointing out the route they were to travel or objects to be moved.

Today he must teach his dogs to follow unspoken commands. Movie animals always play their parts while hungry, for after feeding, they become too lazy to act with dash and snap.

Whether a given animal ever attains sufficient proficiency to work in pictures depends on his own intelligence and his trainer's skill. The better trainers, Renfro told me, may work for a year with a promising beast before leading him into the glare of the powerful sun arcs.

"Our first task," he said, "is to gain the animal's confidence, no matter whether it's a dog, a fine bird, a burro or any of the cat family. Cats, incidentally, are most difficult to train while dogs are our finest actors.

"I prefer to start with a dog from infancy. He learns from the outset I am his master, his friend. Then I play with him as a father would play with his child. Soon he begins to mimic my movements. But during this time I talk to him constantly. If I roll over, I say to him, 'roll over, little fellow.' If I crawl, I give the command at the same time.

"That is not all. I also convey the appropriate sign with my hand, rolling it in a circle or holding it close to the ground and moving it forward to indicate the command for crawling. Gradually I eliminate the first two. For a few weeks I give the oral command and the signal. During each movement, the

animal watches me closely. He learns to associate the three commands, until at last he will follow any of them. When he's ready to graduate, I need only give him a casual hand movement, and he will obey immediately."

Some animals will associate ideas while others can follow only elementary suggestions. Renfro's dog Buster demonstrated the former for me.

"Watch this," said Renfro.

He placed a wood block on the lawn nearby. Then, as the dog observed his master closely, Renfro touched one finger to his nose and pointed toward the block. Buster walked sedately to the object, sniffed once, then began to shove it across the lawn. Because his back was turned, Renfro spoke to the dog. When he turned he saw the trainer holding a card on which were printed the words, "sit down." The animal sat.

Turning to me, Renfro said, "You select a card."

From the stack I pulled out one reading, "Get up on chair."

Buster looked around for the nearest chair, ambled over, jumped up on the cushion and lay down to await the next card. As I selected other cards ordering the dog to "crawl," "stand up," and "turn around," I realized that he was following no set routine, that he actually understood the message conveyed. He associates the particular cards with both spoken commands and demonstrations taught him by Renfro several years ago. On a movie set, Renfro, standing outside the camera line, need only motion with his hand or show Buster a card and he performs as faithfully as any human actor. Which is probably the reason Renfro requires a \$75,000 guarantee against fatal accident to the dog whenever he appears in pictures.

One of the strangest incidents of training I heard of occurred on Kerr's animal ranch on the outskirts of Los Angeles. There, among (Continued on page 90)



To keep this cat quiet while on the movie set, the trainer wet one of its paws. Interested in licking the wet fur, it remained perfectly still

TIRES Torn IN TESTS FOR



After being used on an overloaded test truck, this tire is being dissected to find its weak spots

By Walter E. Burton

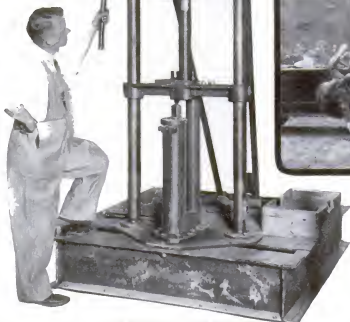
SAFER tires for faster cars! That has been the 1933 goal of the rubber industry. How it has been attained is a dramatic story of strange new methods of research, of scientific torture chambers filled with weird tire-wrecking apparatus, of industrial surgeons whose scalpels cut through layers of rubber and fabric, and of fast-moving laboratories on wheels speeding night and day over highways, mountains, and deserts.

Spinning on treadmills, skidding over curbs on icy pavements, crashing head-on into a brick wall, the latest tires have demonstrated their stamina and safety. Through such spectacular tests, the tire makers have kept pace with the exacting demands of the manufacturers of present cars.

Probably the most severe test any tire ever underwent was given a new low-pressure product on an Akron, Ohio, athletic field. Engineers built a wall of brick and concrete fifteen feet long and three feet thick. They sank it several feet into the ground and reinforced it with a steel beam. When it was finished, hundreds of spectators gathered at the field to see Dick Grace, Hollywood stunt man, drive a car, going almost forty miles an hour, point-blank into this solid barricade.

The machine was an eight-cylinder touring car, weighing 3,000 pounds. The top and windshield had been removed and the front axle advanced several inches so that the front tires would receive the full force of the impact.

After cutting a few dizzy circles over the field to warm up the engine, Grace swung toward the black bull's-eye painted on the whitewashed side of the wall. His hand in the air signaled the start of his spectacular tire-testing stunt.



CAN IT STAND ROAD SHOCKS?

With this testing machine, new tires are dropped from a height upon the anvil beneath them until the fabric breaks. In this way their durability is accurately found

Slow-motion picture cameras began to whirl. The crowd was holding its breath. The big car gained speed rapidly. Spectators could see the driver rising in his seat, drawing his legs under him, ready to jump. But his hand was holding the wheel steady until the last split-second, aiming both tires squarely at the wall.

Before starting the test, Grace had calculated his probable path of travel through the air at the time of the crash. His body, he decided, would be catapulted into the air, over the front of the car and the wall, landing on the ground a few feet beyond. Accordingly, a soft bed of peat moss had been prepared to cushion his fall.

As the car struck the framework the body seemed to fold up like an accordion, the wall tilted backwards nearly a foot, and then settled into its former position as the car bounced back several inches, and Grace landed, not on the soft bed of



CRASHING A CAR INTO A SOLID WALL

Top view shows a car, equipped with new low-pressure tires, striking a wall of brick and concrete while running at about forty miles an hour. Picture above shows the driver hurled from the seat and falling over the side of the car. Note also the flattening of the tire at the point of contact with the wall. The car's framework was badly damaged but it was found that no air escaped from the tires

peat moss, but on the hard ground at the side of the car. The impact had thrown him against the cowl, folding him like a jackknife over it and striking his head on the hood. Then the rebound had tossed him into the air and over the side of the car. In spite of this, his only injury was a minor cut on one knee, where it had caved in the dashboard.

A few moments after the crash, he was eagerly examining the tires. The 3,000-pound car had struck the wall squarely while traveling thirty-seven miles per hour. Almost all of the 170,000 foot pounds of energy had been absorbed by the two front tires. The whitewash from the wall extended for two feet along the tread, and the steel rims were flattened. Yet not a pound of air had been forced from the inner tubes, and no break in the tire structure could be found.

This sensational test is one of many made to determine how much punishment a modern tire will stand.

to Pieces

SAFETY.



Will the tires skid? To find out, the test car is driven onto an icy surface and turned suddenly. Thus skidding properties of the new tires are found

The driver of the test car, left, is wearing an electric car which picks up tread noises. Tests of this sort resulted in a safer and a quieter tire



This truck, equipped with tires to be tested, is weighted with steel beams in excess of any load the tires would be expected to carry. At top, machine that gives inked impression of the tread, showing how much of it touches the ground when in use

Recently, a 10,000-mile road test gave a set of the newest low-pressure tires another gruelling workout. Three Long Beach, Calif., youths drove their roadster to the wild interior of Mexico to photograph the ancient ruins of Monte Alban. They traveled over country where no semblance of a road existed. At one place, they advanced only forty miles in thirty-six hours, so rough and muddy was the trail. The opportunity of realizing the most from their low-pressure balloon tires, however, came when they met a gang of bandits. The outlaws gave chase, but the roadster, on its big, resilient tires, was able to outdistance them over extremely rough ground.

To such outside demonstrations, is added

the queer laboratory tests by the "tire killers" that are now regularly used.

These experts operate a dozen pounding, pulling, twisting devices that put tires through as much wear and tear in a comparatively short time as they would receive in 15,000 miles of driving. Shiny new tires roll into these workrooms, are punished to destruction, and are carried out so much rubbish. But the records they leave behind show weak points and aid in building better tires.

One of the strangest of these testing machines produces a wiggling motion in a tire and enables the engineer to study bead strength, the beads being the strands of steel wire which extend around the base of the tire where it is held by the wheel

rim. Attached to the shaft of the machine is a wheel at one end and a crank at the other. The tire is mounted on the wheel with the tread clamped so it cannot move. Then the crank is turned, giving a wiggling or oscillating action to the tire, which concentrates in the beads and gives them all the strain of hundreds of miles of heavy driving over rough-surfaced roads.

Another machine resembles a pile driver. Its effect on the casing of a tire is similar to that of running over a curb or striking a hole in the road at high speed. The tire is mounted on a wheel and attached to a plunger which, raised and released, allows the tire to strike a steel anvil below. These anvils are made in different sizes and shapes to represent paving bricks, railroad rails, curbs, and other objects motorists occasionally hit.

By varying the inflation pressure, the height from which the wheels are dropped and the shape of the anvil it strikes, the expert in his laboratory can produce any sort of bruise he desires. During this work, the wheel is rotated so the tire strikes the anvil at different points. Sometimes, this machine inflicts as many as fifty severe bruises on the casing of the tire before the punishment is over and the specialists begin their analysis of the result.

Nearby is another tire-torturing device, the pulley-wheel. It looks a little like a two-wheeled mule cart, without the mule, the wheels resting on wide-faced pulleys. The cart is loaded with several tons of scrap iron, tires are mounted on the wheels, and the pulleys rotated. On the face of each pulley are two diagonal ridges, about an *(Continued on page 92)*

HOMEMADE SEXTANT shows How Ships Find Their Way

BY THE SUN AND STARS

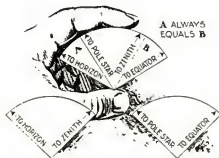


Diagram showing how simple sextant is used to determine latitude from polestar

IF YOU have crossed the ocean, you probably have seen the ship's captain, or his first officer, "shooting the sun." Shortly before noon, he came out on the bridge, sighted toward the horizon for a couple of minutes through an odd-shaped instrument, and disappeared into his chart house.

Had you been watching the bridge at night, you might have seen the same performance repeated while the officer on watch took the altitude of the North Star above the horizon.

In each case, the officer used the mariner's sextant to determine the north and south position of the ship on the earth, or, in other words, to find its latitude at the time the observation was taken.

With a well-made sextant, in experienced hands, the altitude of a ship can be determined by the sun and stars, with surprising accuracy, the margin of error not exceeding a mile or two. This information, plus that furnished by the ship's

compass and chronometer, enables the captain to hold a true course, and, if necessary, go straight to any position radioed by a ship in distress.

Since finding the latitude of a ship at sea is the outstanding application of astronomy to everyday human affairs, everyone should know something about it. So this article will be devoted to the manner of making and using a simple sextant. The determination of longitude will be covered in a later article.

Before we start the job of making a rough cardboard sextant, we must understand why the sun and the North Star, as well as other heavenly bodies, can be used to determine north and south positions on the globe.

In order to illustrate the principle clearly, let us refer to our umbrella upon which star positions are marked and the rod of which represents the polar axis of the earth. The earth itself can be an old tennis ball, split in half, and placed around the umbrella rod, as shown in the illustration. The black band around the ball stands for the earth's equator.

Since it is a little easier to catch on to the way the polestar is used in latitude observations, let us begin with Polaris rather than the sun.

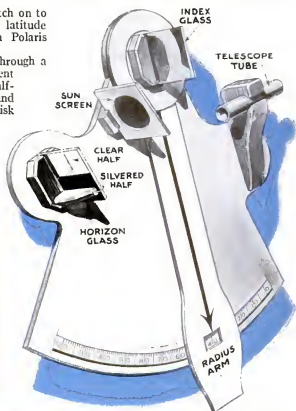
A pin is stuck into the ball through a little disk of cardboard to represent an observer on a ship that is halfway between the earth's pole and the equator. The edge of the disk

represents the observer's horizon in every direction. Since the world's curvature is only a few inches to the mile, the comparatively small circle of sea visible from a ship can be regarded as approximately flat, as our disk is.

Since our earth is a mere grain of sand in comparison with the millions of miles to the polestar, any line parallel with the earth's axis will point just as close to the polestar as the line of the axis does. For our rough and ready purpose, let us say that our umbrella-rod axis points directly to the infinitely remote polestar. Accordingly, a line parallel to it from our observer will also indicate the star.

For the same reason, it follows that a plane drawn parallel to the earth's equator through the observer will cut the starry globe of the sky along the same circle as the plane of the earth's equator itself does. If you think of the earth as a grain of sand in stellar space, you will have no trouble in getting this idea.

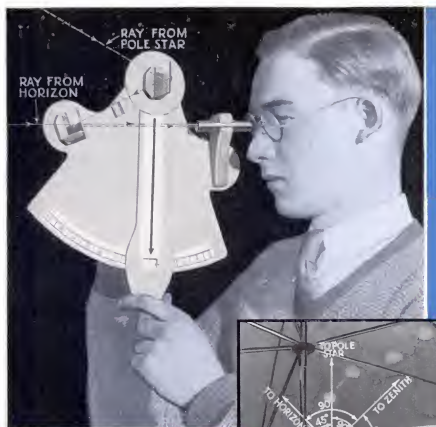
With this point settled, it is easy to see how latitude is found from an observation



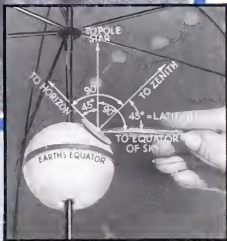
HOW YOUR SEXTANT WILL LOOK. This is how a homemade sextant looks when assembled. Note, sun is south of equator in winter and north of it in the summer

UMBRELLA SOLVES LATITUDE PROBLEM. In the picture below, the earth's orbit around the sun is indicated by the cardboard hoop. The plane of the earth's equator and its prolongation among the stars is indicated by the black line on the ball and chalk line on umbrella, which is tilted in line with earth's axis





YOUR SEXTANT IN USE. In taking an observation, rays of light from the horizon reach the eye through the clear half of the horizon glass. Rays from the polestar reach the eye by reflection from the mirror. When by moving the lever arm, the star's image is made to coincide with the horizon, its elevation is read on the scale. Diagram at the right shows exactly why this is always true in any latitude



of the polestar's height above the northern horizon.

It is plain that the observer's line of sight to the polestar makes a right angle with his line of sight to the equator of the sky. It is also apparent that his horizon is at right angles to the zenith, a point directly over his head.

Now cut two accurate quarter circles from a sheet of writing paper and a moment's experimenting with them will quickly show you how latitude is found. First label the edges of the quarter circles as shown in the drawing and then hold them up toward the light with their curves and points coinciding.

As you now hold the quarter circles against the light and rotate them upon each other around their common center, you will notice that the angle between the line to the polestar and the line to the horizon will always exactly equal the angle between the line to the zenith and the line to the equator. As the first angle is increased in size, the second increases with it, and vice versa.

You can now see that as soon as our observer has measured the angle of the polestar above his horizon, he has also measured the distance of his overhead point, or zenith, from the point where the plane of the earth's equator cuts the sky. This means that he has found his latitude, for latitude is simply his distance north or south of the equator.

Suppose our observer finds that the polestar is forty-five degrees above the horizon. Then he knows at once that his position is forty-five degrees north latitude.

If the sun crossed the sky every day in the exact plane of the earth's equator, a skipper could find his latitude from it almost exactly as he does from the polestar. After measuring with his sextant the height of the noon sun in degrees above the southern horizon, he would need only to subtract this from ninety degrees, the distance from his zenith to his southern horizon. The number of degrees remaining would be his latitude.

The sun, however,

SHIP'S CAPTAIN FINDS LATITUDE

If a ship's officer wanted to find his latitude off northern Florida on next October 20, he would shoot the sun at noon and find it fifty degrees above the horizon, or as the diagram shows, forty degrees from the zenith. As the declination of the sun on that date will be ten degrees, the officer subtracts to get latitude

This Article Tells How to Make and Use an Instrument with Which You Can Find Latitude of Your Own Home

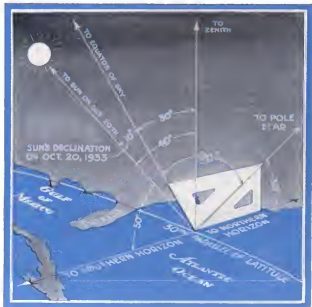
By
GAYLORD JOHNSON

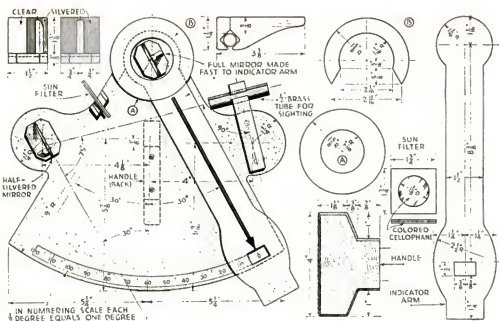
only crosses the sky in the plane of the equator on two days of the year—once in the spring, and again in the fall. On all other days, its path is at a constantly varying distance north or south of the equatorial plane. Accordingly, a skipper must correct his observation of the sun's height by the distance that the sun is north or south of the equatorial plane on that day. This difference is called the sun's "declination" and is given for every day in the year in the Nautical Almanacs published by all governments that have navies or mercantile shipping.

In summer, when the sun's declination is north of the equator, the correction must be *added* to the distance between the sun's position and the zenith, in order to obtain the latitude. In winter, when the sun's path runs south of the equator, the declination is *subtracted* from the distance between the sun's position and the zenith.

When you made your crossbow rule for measuring angles between stars in the sky (P.S.M., June, '33, p. 42) you were re-inventing the device that was the great-grandfather of the modern sextant. Mariners once used the crossbow rule, or cross staff, for the purposes the sextant now fulfills with far greater accuracy.

The photo-diagrams and scale plan shown on the first page of this article, give all the measurements and arrangement of parts necessary to build a model sextant, with which you can find the approximate latitude of your home. You can do this by taking the altitude of the North Star or





Drawing of parts and dimension necessary in making your own sextant

the sun. In employing the sun, observe it for a couple of minutes before noon. The sun's distance from the horizon will increase slowly until it is exactly on the meridian. After that it will decrease. The mariner's object, and yours, is to measure the sun's angular distance from the horizon when it is at its highest point.

To do this, look at the horizon through the telescope tube on the sextant. Then move the radius by its handle until the sun comes into your field of view. Move the handle gradually as the sun ascends to the meridian, keeping the sun on the horizon line. When the sun ceases to rise, stop observing and read the figure from your sextant's scale.

When you have read this angle on the scale of your sextant, subtract the number of degrees from ninety. This gives the sun's zenith distance. To this add or

subtract the sun's declination for that day, depending upon whether the sun is north or south of the equatorial plane.

If you make your observation on Sept. 23 or 24, you can neglect the sun's declination as it is then crossing the equator, and the correction is less than one-sixth of a degree.

In observing the sun, you will of course need some sort of a dark screen to protect your eyes from the glare. I made a satisfactory screen by fastening eight thicknesses of green cellophane together between small cardboard masks, and attaching the screen to the sextant in the path of the sun's rays reflected from the index mirror to the horizon mirror. You can, however, use a piece of glass smoked in a candle flame, and protected by another plain glass fastened over it.

The sextant's construction and prin-

ciple of operation are made sufficiently plain in the illustrations. It is necessary only to add a word of caution. Be sure to reinforce the cardboard frame so that it will remain flat, or build it from laminated wood. Also, take care that the two mirrors are perpendicular to the frame and parallel to each other when the arrow points to zero on your sextant's scale of angles.

It is better to make the degree scale on a separate piece of Bristol board and attach it after the mirrors are actually parallel. It is easy to prove that they are in this condition by sighting at a distant telephone pole or steeple, and moving the radius arm gently until the two images of the object blend into one. Then attach your scale with glue, and your sextant will be correctly adjusted for altitude observations.

The horizon glass is easily prepared by scratching off the silver (Continued on page 91)

SUN'S DECLINATION

Distance North or South of Equator
at Weekly Intervals

+ sign means Sun is North of Equator

— " " " " South " "

Sept. 1.....	+8 degrees 53 minutes
Sept. 8.....	+5 " 57 "
Sept. 15.....	+3 " 17 "
Sept. 22.....	+0 " 35 "
Sept. 29.....	-2 " 8 "
Oct. 6.....	-4 " 51 "
Oct. 13.....	-7 " 31 "
Oct. 20.....	-10 " 6 "
Oct. 27.....	-12 " 33 "



NEW SAFE WAY TO TEST RADIUM

TESTING the strength of the rays from radium and other materials, without exposing research workers for long periods to the dangerous radiation, is made possible by an electrical hook-up devised by Government experts at Washington, D. C. By the new method the experimenter approaches the specimen only to

place it in, and remove it from, a small rack beneath a hollow metal chamber. Radium rays penetrate this "ionization chamber" and, according to their strength, render the air more or less electrically conductive. This effect is registered, through vacuum tubes and an amplifier, upon a sensitive electric meter near experimenter.

Specimen of radium, left, being placed in small rack beneath an ionization chamber to measure strength of rays

After specimen is in place, experimenter retires to safe distance, right, and watches light beam that shows on scale strength of tested radium



Is He the *Fastest* Wood Carver?

TURNING a shapeless block of wood into an accurate model of a dinosaur or a saber-toothed tiger in half an hour is easy for Rudy Hofmeister, expert wood carver for the New York firm of Messmore and Damon, builders of theatrical effects. Beneath his nimble fingers, the prehistoric animal takes shape so rapidly that the eye can hardly follow his swift, deft movements. Pictures on this page, made especially for POPULAR SCIENCE MONTHLY, show the successive steps in carving a dinosaur. He started at twelve o'clock, and the time required for each stage is shown on the clocks.

Rudy Hofmeister, who carves models of extinct animals with a speed believed unequalled



1 From a solid block of wood, the outline of a dinosaur is cut with a hand saw. This is the only machine operation in the making of these models



2 Then with a knife, Hofmeister swiftly removes excess material and roughly shapes out the piece of wood



3 At this stage, the tail and legs are being roughed out. This is the last of the heavy cutting that is done on the model



5 The final process consists in burning the model with the point of an electric needle which makes the wood look like the real skin of the animal

6 Our photographer poses the completed dinosaur against a realistic background amid surroundings cleverly constructed to look like the habitat natural to the monster of prehistoric ages



Plants Saved from Plagues by Birth Control



This single row of melons, right, is strong and healthy in a field where all the others are blighted by disease. They are flourishing because an immunity to plague has been created by selection.

To secure disease-resistant lettuce, the bloom is rinsed with a water spray, left, and fertilized by hand. In the background are plants protected by paper bags. Below, immune melons at left and, at right, blighted melons.



HIGH-SPEED plant breeding and rigid birth control methods have enabled Ivan C. Jagger, government expert, to produce new strains of lettuce and cantaloupe immune to disease. His conquest of brown blight and mildew will save fortunes for growers in California and Arizona, who furnish three-fifths of the country's canteloupes and

nearly half its lettuce. Jagger grew a crop of each plant in the spring and a second, from the seeds of the first, in the fall, thus crossing various varieties

will be a boon to growers who, in the past, have seen their fields ravaged by the plagues for which no effective means of control has been developed.

for ten generations within five years. Bags were placed around the plants to prevent natural pollination from spoiling the hybrids. The result of his work—seven disease-resistant strains of lettuce and two of cantaloupe—

READY TO TEST NEW HELICOPTER

NEARLY ready for its first tests is an airplane of odd design, built by a New Jersey inventor in an attempt to solve the problems of vertical flight. A horizontal airplane propeller tops the machine,

with windmill vanes just beneath. These, the designer hopes, will enable his plane to lift itself straight up, hover motionless in the air, or land in a space of its own length with practically no forward motion.



NEW DRAWING MACHINE

SIMPLIFYING the draftsman's task, the machine seen above transforms complicated plans into perspective drawings. When a plan is tacked to the top and a crank is turned, principal points of the perspective view are indicated clearly and accurately on the drawing paper.





TRUCK PLANTS FIFTY-FOOT TREE

FIFTY-FOOT trees are easily planted by means of a jointed truck with a pivoting cradle, recently developed. Its front wheels run out on planks laid across the hole made to receive the tree, as seen above, thus bringing the

rear wheels and cradle to the hole's edge. Then the front wheels are detached and the planks removed. By means of a block and tackle, the cradle is allowed to rock on its pivots, slowly lowering the tree into the hole as at left, and all the time holding it so it can't fall over.

FIRST BROADCASTERS USED PHONE

Who were the earliest broadcasters? Ten years before the first radio programs were put on the air, a group in Chicago, Ill., regularly delivered musical programs and news bulletins over the telephone lines of many subscribers. The rare old photograph reproduced below shows these pioneers broadcasting from their studio. Each sing-

er is holding a microphone, while other individual microphones are attached to the instruments. To listen to the music, a subscriber had merely to sit beside the telephone and hold the receiver to his ear. If he received a 'phone call while listening, the musical program was automatically disconnected.



First broadcasters used microphones attached to their musical instruments



Color photo produced by superimposing dyed sheets, still wet, as seen at left

NATURAL-COLOR PHOTOS MADE ON CELLOPHANE

NATURAL-COLOR photographs are made upon sheets of dyed cellophane in a new and simplified process worked out by two government photographers. The results are said to have unusual lifelike quality. Three exposures, one for each primary color, are made and the negatives are printed on cellophane sheets. The images are then dyed in their proper colors, superimposed while still wet, and affixed to paper.

War Waged on INSECTS

*Orchards and Garden Vegetables Protected
From Pests by Strange Traps and Processes*

ELECTRIC lights, screen doors that electrocute anything attempting to fly or crawl through their meshes, and mechanical traps that lure their victims by means of odors are among the newest weapons to be used in the warfare against insect pests. Such devices make summer porches inhabitable, increase the yield of such fruit crops as apples, keep flies from injuring stock, and provide abundant food for fish in outdoor ponds.

A professor in a midwestern college found it impossible to remain comfortable on his screened-in porch in summer because of the mosquitoes and other insects that were attracted by the lamps on the porch. He placed a brilliant lamp outside, beneath the eaves and not far from the screen-wire. At once the insects began crawling through the screen or, if too large, collecting on it, in an effort to reach the bright light. The professor is now able to read his books in peace because his dimmer, shaded lamps no longer act as bug magnets.

Light-trap experiments of the New York State Agricultural Experiment station at Geneva, performed in apple orchards at Hilton, point to a new way in which the fruit grower can realize greater profit from his trees. Similar studies have been carried on in other parts of the country, with promising results. At the present time, this work is not complete, so that conclusions drawn from the results of tests may need later revising.



DAMAGE DONE BY FRUIT PESTS

Agricultural experts of New York State examine apples at right to determine amount of damage by various insect pests.



SCREEN KILLS FLIES BY ELECTRICITY

Below is shown how an electrically charged grating placed on the door of a cattle barn protects the cows by exterminating the little pests.



ELECTRIC TRAP GUARDS TREES

This trap has proved useful in safeguarding orchards. It is suspended in a tree and kills insects attracted by light.

The New York experiments consisted of lighting parts of an orchard with lamps which formed portions of traps, leaving other parts unlighted for the purpose of checking results. Some of the trees were sprayed with chemicals commonly used for insect control, while others were not treated.

Three different lighted areas were used. In one, water-pan traps were placed in every tree. In the second plot, water-pan traps were placed in every second tree in every second row, making one trap for four trees, or twenty-eight traps in four acres of orchard. The third area, containing forty-four trees, had, in every tree, a type of trap that electrocutes insects as they pass between its bars in an effort to get near the lamp inside. The water-pan traps were hung from the larger limbs, two or three feet from the trunk. The electric traps were suspended from the tops of the trees.

From June 1 through August 4, 1932, all of the traps captured 8,782 codling moths, 43,321 bud moths, and 72,928 fruit tree leaf rollers, all of the insects being decidedly injurious to apples.

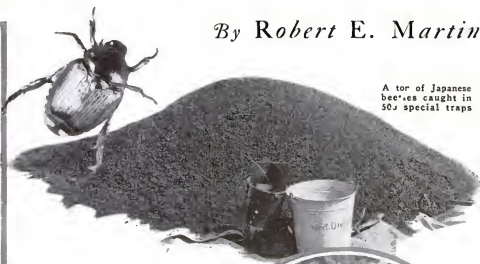
Examinations of captured insects during the several years that the trapping work has been carried on have revealed that there were about an equal number of males and females, and that many of the females had not yet laid eggs. It is believed also that the mere presence of

with Lights and Odors

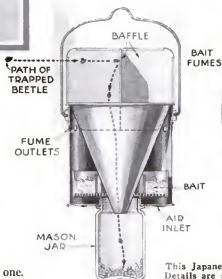
By Robert E. Martin



Small electric light placed over a park lake draws insects which, as they fall in lake, feed the fish



A tor of Japanese beetles caught in 50 special traps



This Japanese beetle trap uses an aromatic odor to attract the pest. Details are shown at left. It was developed by Department of Agriculture experts for use in the parks of Washington, D. C.



lights reduces the amount of egg laying, and thus reduces the crop damage later in the season.

The number of insects captured does not necessarily measure the value of the trapping activities, according to Donald L. Collins, who has been carrying on the work at the New York Station. The actual, dollars-and-cents benefit can be determined only by comparing the fruit yield of the lighted orchard with that of a similar unlighted one.

At the New York orchards, apples which had dropped from the trees were picked up and examined. Then 400 apples still on each tree were checked. Examiners inspected each apple carefully, noting the number of stings, the number of deep codling moth injuries or worm holes, and whatever other damage had been done by insects to the ripening fruit.

Counting both apples on the tree and those that had dropped to the ground, the following facts were obtained:

Clean or undamaged apples per 100 apples, 67.15 in lighted areas, and 37.04 in unlighted.

Number of apples having worm holes, per 100 apples, 11.33 in lighted areas, 26.76 in unlighted.

Number of worm holes per 100 apples, 16.13 in lighted areas, 47 in unlighted.

These figures, together with others obtained at various times, indicate that lighted orchards yield about 30% more uninjured apples than unlighted ones; that there are twice as many apples containing deep worm holes in unlighted areas as in lighted ones, and that almost three times as many worm holes occur in unlighted sections as in those which are lighted.

Further experiments were carried out to

find the best combination of light and chemical sprays. Some trees were lighted but not sprayed, some were lighted and sprayed, others were sprayed but not lighted, while still others were neither lighted nor sprayed.

A surprising result was that trees which were lighted but not sprayed produced apples having about the same number of worm holes as trees which were sprayed but not lighted. Apples from the unlighted, unsprayed control trees showed twice as much injury as either of these, while trees which were both sprayed and lighted were about three times as good as the unsprayed—lighted and unlighted—sprayed trees; and were six times as good as trees which had received neither kind of protection. These conclusions are based, by Collins, on figures showing extent of codling moth injury, or the number of deep worm holes.

Figures so far obtained at the New York experiment station indicate that the use of light traps among apple trees reduces to a considerable extent the amount of injury by the codling moth. Tests which have run over a four-year period in one area indicate that the use of light traps

decreases the codling moth injury each year over that of the previous summer. The discovery that the use of incandescent lamps is as effective as the use of sprays in the control of codling moth injury surprised investigators, and has led them to make further careful studies along these lines with various kinds of lights.

Collins has issued a reminder to fruit growers that his experiments are not to be taken too seriously, until they have been carried on through a sufficient number of seasons to make the results reasonably certain if correct technique is used.

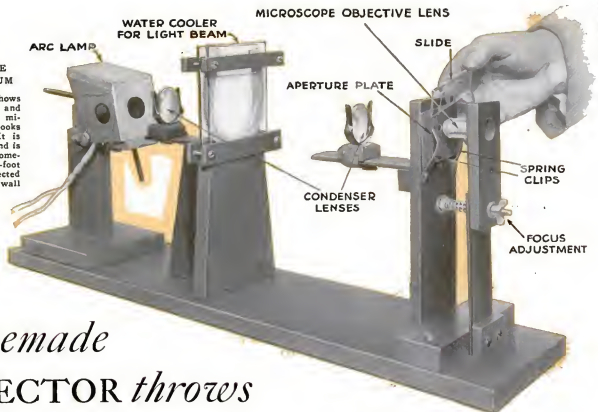
"However promising these figures may appear," he says, "we do not yet consider ourselves in a position to make definite recommendations. It is hoped that another year's experiments will settle any doubtful points."

The adoption of a new electric screen door would make life more comfortable for thousands of cows and horses by destroying the flies that pester them.

The new fly-killing door works on the same principle as the electric insect trap used in the New York orchard experiments. The upper part [\(Continued on page 94\)](#)

HOW TO MAKE MICRO-VIVARIUM

This photograph shows the essential parts and arrangement of the micro-vivarium as it looks when completed. It is easily constructed and is lighted with a home-made arc light. Six-foot images may be projected with it on screen or wall



Homemade PROJECTOR *throws* Microscope "Movies"

CAN you imagine anything more thrilling than a germ's-eye movie of our fantastic universe of the microscope? A living picture of that strange world of the amoeba, the spore, and the algae, thrown on a six-foot screen, revealing the daily habits of microscopic actors as they fight, forage, and reproduce.

The amateur microscopist need not journey far to view this novel moving picture show. Your sitting room can be the theater, a white wall the screen, and a simple homemade micro-vivarium the projector.

With this inexpensive piece of apparatus, you can produce your own dramas of the microscope in true Hollywood fashion.

Strife, death, and tense adventure will unfold before your eyes in an ever-changing pattern of queer microscopic life. And for all this, five dollars spent for materials will be your ticket—good for a lifetime.

Until you have viewed a drop of water as the micro-vivarium projects it, you have missed the most beautiful and interesting of all sights. Tiny living creatures, enlarged until they dwarf even the largest gold fish, swim and dart across a giant circle of light. Fantastic animals and grotesque plant life parade before you like a scene viewed through the port-hole of Jules Verne's magic submarine.

But let us get on with our work. You will have plenty of time to marvel at

this mysterious wonderland at first hand.

Although you will have to buy a few of the materials for your micro-vivarium, the objective lens of your microscope will form the most important part. The rest of the equipment consists of a baseboard, two inexpensive eyeglass lenses, an improvised water cooler cell, and a home-made arc lamp.

Since the two condenser lenses (A and B) are to be arranged so they are movable, the exact position of each support on the one by six-inch by three-foot baseboard is unimportant. For convenience, the center support can be placed approximately in the middle. All three supports can be assembled and fastened in place with brads or screws and glue.

As you can see by studying the photograph and drawing, the main front support performs a double function. A projecting arm at the rear takes the movable condenser lens B and the support itself contains a metal plate having a one-fourth inch aperture drilled in its center. Naturally, the aperture must be placed over a larger hole in the wood support. Two spring clips fastened on each side of the plate serve to grip the ends of the microscope slide and hold it in place over the aperture.

In front of this main front support and attached to the same base block is an adjustable spring holder for the objective lens of your microscope.

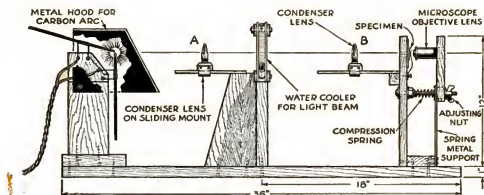


Diagram showing the manner of constructing and assembling your own micro-vivarium



A Startling Vista of Living, Moving Creatures Projected on the Screen

on Screen

You can make this by fastening a one-half by two by six-inch wood block, having a hole drilled through it to be a tight fit for the upper end of your microscope objective lens, to a two-inch wide strip of springy metal. Be sure the support is long enough to bring the center of the objective in a direct line with the condenser lens and aperture. Everything must be carefully lined up if you want to get the best results.

A wing nut threaded on the projecting end of a long bolt passed through horizontal holes in the main support and objective holder forms the focusing adjustment for the microscope lens. A lock nut screwed up tight against the front face of the main support prevents the bolt from turning. To make the focusing adjustment positive in its action, you can slip a coil spring over the bolt shank between the two supports.

The center support holds the water cooler and the condenser lens A. The water cooler is one of the most important parts of your projector. It cools the hot beam of light and prevents it from heating your living specimens entombed in the tiny

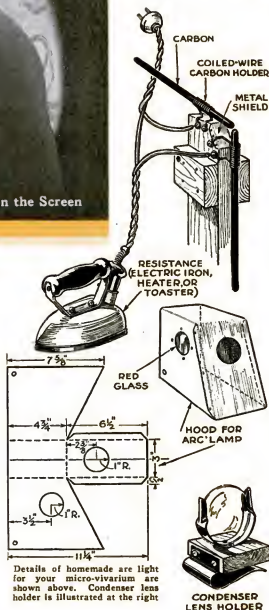
glass slide that will form your microscope aquarium. Without it, your tiny actors would meet a horrible death by boiling.

Two sheets of good-grade window glass, a short length of rubber tubing, and two homemade wooden clamps are all that you will need to assemble the cooling cell. Bend the tubing U-shaped, place it between the two pieces of glass, and hold the parts together with the clamps. The U-shaped tube, pressed tightly between the rectangles of glass, will form a water-tight well. Using brads or screws, fasten the water cell in place in a shallow notch cut in the front of the center support.

Although simple biconvex lenses were used as the condensers in the original, a combination of eyeglass lenses costing about a \$1.50 each has been found to be far superior. You can buy the right type of lens from any optical supply house or through your neighborhood optician. Lens A should be a forty-millimeter diameter eyeglass lens having an eighty-four-millimeter focus and lens B a forty-millimeter diameter lens having a fifty-millimeter focus. A lens set of this type can be used with either an eight- or a sixteen-millimeter objective lens.

For the light source, you can use any form of arc light you may have on hand

By
**Morton C.
Walling**



Details of homemade are light for your micro-vivarium are shown above. Condenser lens holder is illustrated at the right

KEEPING SPECIMENS ALIVE

In order to exhibit your specimen more than once, you can keep it alive by slightly moving cover glass and adding occasionally a little more water

(P.S.M., July '30, p.99), or you can make one from scraps of wood and metal and two short lengths of stiff wire.

If you follow the inexpensive arrangement shown, your first job will be to wind the stiff wire into two tight coils that will be a close sliding fit for the type of carbons to be used. If you have alternating current, both carbons should be of the eight-millimeter variety. With direct current a six-millimeter carbon should be placed in the vertical position and an eight-millimeter carbon in the horizontal position.

Mount the wire carbon holders at the top and front (Continued on page 83)

RADIO-CONTROLLED CRAFT TO ADD TO MOVIE THRILL

TO THRILL movie audiences with more spectacular crashes and collisions, without risking the life of a stunt man, a prominent Hollywood, Calif., film studio is experimenting with radio control for airplanes, speedboats, and trains. An airplane with no one aboard, for example, could thus be sent plunging to earth in a spin that no sane aviator would dare to try. Short-wave signals from a keyboard-operated transmitter, picked up by a receiver aboard the craft, would work its controls through relays. In the photograph, a model radio-controlled locomotive is being used.



With this machine, loud noises are sounded in the ears of deaf persons and, thus exercised, hearing improves



LOUD NOISES HELP THE DEAF

BASED ON the theory that exercise of the eardrums aids certain cases of defective hearing, Dr. J. B. Prager, of New York City, has devised a phonograph that subjects patients, through earphones, to loud noises. His records include dynamite explosions, the shrieking and clanging of fire engines, thunderstorms, and waves beating on rocks. Knobs on a panel resembling a giant radio set regulate the volume. The full blast of a fire siren may at first produce only a pleasant tingling in the ears, Dr. Prager reports.

ESKIMO'S MAP OF DRIFTWOOD



AN ESKIMO, who had never before seen a map, has just provided the Library of Congress with the first accurate chart of the islands of Disko Bay, Greenland. After a careful survey by sledge and kayak, he whittled relief models of the islands from driftwood and painted them in colors to show lakes, marshes, and vegetation. Sewed to sealskin, they form the map illustrated at left.

KALSOMINE BRUSH CLEANS ITSELF

EASY to clean after use, a new kalsomine brush is provided with a detachable handle. When this is removed and ordinary garden hose is screwed in its place, a turn of the faucet sends a spray of water through the hollow stock and the bristles, cleaning them right down to the base. The brush may also be attached to a threaded faucet.

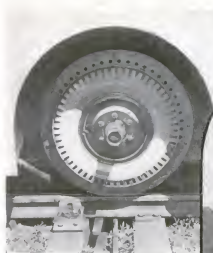


SPRINGS IN AUTO WHEEL



AN AUTO wheel with built-in springs, developed in England, frees the user from fear of punctures and blow-outs. Its tire is of solid rubber. Seven leaf springs, arranged in a circle within the rim, absorb road shocks and serve as spokes to support the hub. A cover plate is bolted over the wheel to exclude water and dust; it is shown removed, in the photo above, to reveal the interior construction of the unusual wheel.

Rail Car Has Steel-Covered Pneumatic Wheels



Closeup of pneumatic tire for railway car shows it within its steel casing. Below, cab of new car with steering-wheel throttle



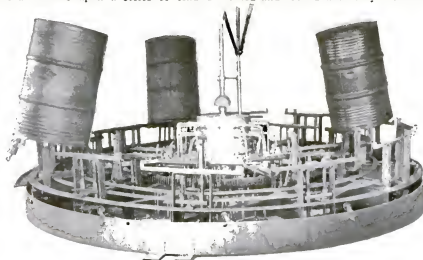
Running on its steel-shod pneumatic tires, the new railway car is seen matching speed, on the Long Island Railroad, with a crack express train

ROLLING on pneumatic tires that never touch the rails, a high-speed railway bus of new design recently made its debut in a test on the Long Island Railroad, near New York City. Two gasoline motors controlled with a throttle resembling a steering wheel drive the car at speeds up to ninety miles an hour. It seats forty-two passengers, weighs only ten tons, and its economy of operation is expected to adapt it especially to branch-line service. The air-filled tires that support the car are encased in steel flanged wheels that roll upon the rails in the usual way. Through this design, the shock-absorbing qualities of pneumatic tires are secured, with little danger of a puncture. The steel wheels float free of the car frame, on their own axles, unless a puncture occurs; then they take the full load after the car has dropped three-fourths of an inch.

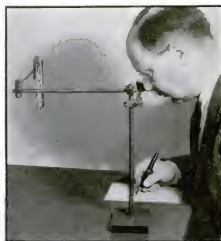
MERRY-GO-ROUND CLEANS OIL DRUMS

SEEKING an improved way of cleaning empty oil drums so they could be used again, an Eastern oil concern devised the "merry-go-round" for barrels illustrated below. As many as twelve drums may be placed at once upon a series of cradles

arranged in a circle. When the power is turned on, they travel around a circular track. Various cleaning solutions are automatically sprayed into the bungholes at the proper time, while the barrels are tilted and rocked until they are clean.



Power-driven merry-go-round that automatically cleans big oil drums



NEW INSTRUMENT MAKES PICTURE COPYING EASY

AN INEXPENSIVE new instrument for home use, resembling in principle the comparatively costly camera lucida used in professional art work, enables an amateur artist to copy any picture. When the picture is clipped to a holder and the user peers into an eyepiece, as shown above, an arrangement of glass panes and mirrors projects an image of the picture upon his sheet of drawing paper.



OLD RUINS OF CLIFF DWELLERS PRESERVED IN 10,000 PHOTOS

FEARFUL lest an earthquake or rock shift wipe out the picturesque, crumbling cliff dwellings of Mesa Verde National Park, in southwestern Colorado, government engineers are taking steps to preserve records of these ancient habitations. In one of the most ambitious projects of its kind ever undertaken, more than 10,000 photographs and prob-

ably as many sheets of blueprints and drawings of the ruins will be made. Then, should a catastrophe destroy the 3,000-year-old village, its priceless records of an early civilization will not be lost; for architects could restore it in its entirety from the plans on file. Every mark on every stone is being charted and photographed, including carvings and paintings that had escaped discovery until the government experts began their work.



TEST VIBRATOR SMASHES PROPELLERS



This propeller is being examined for signs of wear following its ordeal on the electric testing machine

TO LEARN why airplane propellers break, experts of the U. S. Bureau of Standards are wrecking them with a device of their own contriving. The propeller is mounted on the shaft of a direct-current electric motor, whose field coils are supplied with current in the usual way. Alternating current is fed to the armature from a variable-speed generator, making the propeller jerk back and forth. This simulates vibration caused by explosions in airplane engine cylinders. Shaken at certain speeds, propellers break after five to ten hours. The data will help make planes safer.



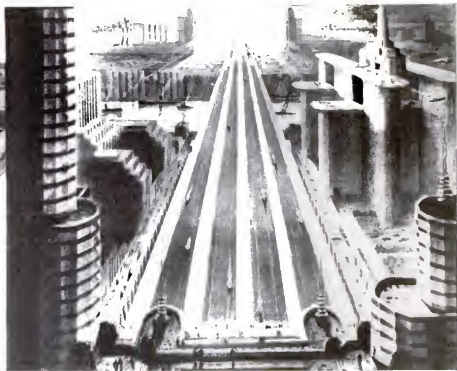
GOBS TO GET RAKISH CAPS

NO LONGER will the broad, flat-topped caps of gobs be seen upon Uncle Sam's war vessels. Under recent orders of the Navy Department, they are to be replaced by hats "of greater rake and flare," which will be issued next month. The new style of headgear (top), is contrasted with the old in the accompanying photographs at left.

New Road Paving Makes High Speed Safe



SUPERSPEEDWAYS from coast to coast are envisioned following the recent discovery in a Boston, Mass., pavement testing laboratory of a new type of non-skid, resilient asphalt paving. It will permit motor cars to travel at speeds up to 100 miles an hour, the laboratory's engineers say. Walled-in traffic lanes, with block signals, would permit such speeds in safety. Hundreds of different kinds of pavement were tested, and Sir Malcolm Campbell, world's speed king was consulted during the tests.



Here is an artist's conception of the proposed 100-mile-an-hour transcontinental superhighway made possible by non-skid paving material. At upper left, testing samples during research



Watches on stand, center of picture, are being regulated in less than a minute by the use of the new time microscope

TIME MICROSCOPE CHECKS WATCH

A JEWELER may require days to regulate a watch precisely, but a new device known as a "time microscope," developed by a Lancaster, Pa., watch firm, tells in one minute whether it is running fast or slow, and how much. Besides providing a quick method of adjusting a customer's watch, the invention is a useful tool for factory inspection. A revolving mirror driven by a variable-speed motor in the base of the lamp standard (at left of picture) throws intermittent flashes of light on the balance wheel of the watch (center). By adjusting the speed of the motor, the balance wheel may be made to appear stationary. When it is held so for one minute, the dial at the rear indicates the number of seconds that would be gained or lost per day. Then adjustment is easy.



FIRE ESCAPE TRAP IN TOP OF AUTO

A MOTOR car with a fire escape is a novelty introduced by a British inventor. The top of the car is cut away to provide a large rectangular aperture, which is normally closed by a fitted panel that excludes rain and snow. If an accident should turn the car on its side, however, the panel automatically falls out, thus allowing the occupants to escape or be helped out quickly. In case of fire following a collision, the inventor declares, his innovation would be an invaluable aid to life-saving and would probably greatly reduce the number of serious injuries that occur when driver is trapped in car.



This panel in top of auto falls out affording a means of escape if the car turns over on its side

COUNTER ON TELEPHONE KEEPS TABS ON CALLS

So A telephone subscriber may keep track of his calls and check up on his expenses, a new accessory provides a counter that is pressed each time a local call is made. At any time of the month the subscriber has a visible record of his use of the instrument since his last bill. The device, illustrated above, also includes a handy memorandum. Its use is said in no way to interfere with the operation of the telephone and entails no additional manipulation on the part of the user.

HOMEMADE HYDROELECTRIC PLANT LIGHTS HOUSES AND RUNS RADIO

CONSTRUCTED of junk parts at a total cost of \$20, a homemade hydroelectric power plant is supplying current on the farm of William E. Howell, Decatur Island, Wash. The water wheel is built up on half of a rear automobile axle, and the two-foot, V-shaped buckets are constructed of cedar planks. A thousand gallons of water a minute run down a 217-foot flume from a small creek and strike the buckets after a five-foot drop, spinning a one-fourth-horsepower, thirty-two-volt motor of washing machine type which is used as a generator. The electricity thus produced by the "backyard" hydroelectric station is sufficient to light two houses, the barn and outbuildings, to operate an electric washer, sewing machine, vacuum cleaner and sheep-shearing machine, and to run the builder's amateur radio station, with which he talks to the mainland.

At right is a general view of the homemade hydroelectric plant built at a cost of \$20. Below, another view of its flume with the water striking against the water wheel mounted on the axle of an old car



ROBOTS WITH SENSE OF FEEL, GRADE DIFFERENT FABRICS

WHAT is the difference in feel when you run a strip of velvet, a piece of linen, or a woolen blanket between your fingers? Though an exact appraisal of this quality, when it comes to distinguishing between two fabrics nearly alike, means dollars and cents to the textile manufacturer or buyer, no exact scientific standard existed until U. S. Bureau of Standards experts recently set out to devise one. The result was the creation of a pair of mechanical robots with the sense of feel. One of them, called the "flexometer," above, measures the stiffness or limpness of cloth by flexing it much as you might rub it between your hands. The other, the "compressometer," upper right, measures the hardness or softness of a fabric, the quality that spells the difference between a hard carpet and one into which the feet sink.



REDHEADS KEEP THEIR HAIR, BLONDS LOSE IT

REDHEADED people are the least likely to become bald; blond people the most likely. Men doing active physical work have less trouble with baldness than those in sedentary occupations. Those with high nervous tension are prone to lose their hair. The depression has increased baldness in the United States. These are some of the conclusions reported to the American Association for the Advancement of Science by scalp experts as the result of a recent survey.

THREE-EYED CAMERA SPEEDS MOVIE WORK

TO SPARE his subjects the annoyance of delay, an ingenious still photographer for a Hollywood, Calif., movie studio has fitted the front of his camera with lenses of three types, all mounted on a revolving turret. No high-salaried star need fidget while the photographer goes to his kit for a lens giving a different portrait effect, for a twist of the turret snaps the new lens into position. The three-eyed camera repays the photographer, too, with its convenience in handling and the time thus saved.



Each of the three lenses mounted on this camera can be switched quickly into position



ELECTRIC BICYCLE HORN

BICYCLE riders can honk right back at motorists with the shiny electric horn illustrated above. It gives a loud warning at the touch of a button on the handlebar. The horn operates from a standard dry cell and one battery is said to be good for 25,000 blasts. If desired, the horn may be run from the same battery that supplies current for a headlamp.

Camera Analyzes Meteors

Using cameras instead of test tubes, Harvard astronomers are analyzing the elements in shooting stars. During the momentary flashes of meteors, fifty or seventy miles overhead, special spectroscope cameras record the color bands which indicate the presence of different elements. So far the astronomers have been successful in using this long-range method of analysis on nine meteors. Six of these were

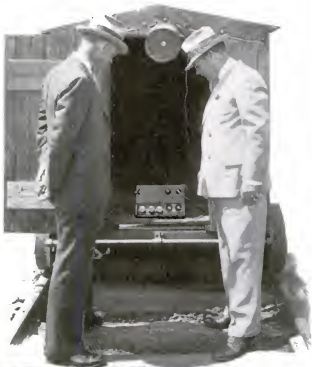


Spectroscopy camera plate on which meteor, left, is photographed to find the elements of which it is composed

mostly stone. All contained some iron. Four had some calcium, three magnesium, four manganese and two aluminum. One of the earth's most abundant elements, silicon, was rare in the meteors.

RAILS CARRY TRAINS' PHONE CALLS

COMMUNICATION between nearby railroad trains, between a train and a way station, and between the engine and caboose of a long freight train, is made possible by a new signal system developed by General Electric Company engineers. The track rails serve as the medium to transmit the signals. When the conductor of a train, for example, speaks into a telephone transmitter, his voice is amplified and sent out along the rail by an inductor coil mounted on the bottom of the caboose near the rail, although not in contact with it. At the receiving end, a similar inductor coil picks up the waves from the rail and makes them audible by means of a five-tube receiving set and a loudspeaker. Although radio apparatus is used, the signals are not broadcast but go direct to the intended place.



This is the receiving outfit for train-to-train communication. It consists of a loudspeaker, at top, and a five-tube receiving set. Left, inductor coil used in system



GLOW LAMPS ON HIGHWAY

BATHED in dazzling yellow light, a half-mile stretch of highway at Schenectady, N. Y., invites motorists at night to step on the gas and speed in safety. The unusual illumination comes from heated sodium vapor. Such lamps have been put in service abroad, but this is their first practical trial in this country. The photographs show the Schenectady highway and one of the new lamps. Their installation in the railway car yards of New York City where illumination is necessary is now contemplated.



Newest HOUSEHOLD Devices



MOTOR IN MIXER'S BASE. Danger of oil getting into the food is eliminated by placing the motor in the base. A condenser is installed in the base to prevent the mixer from causing radio interference.



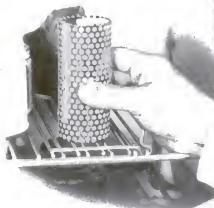
NO HANDS ON CLOCK. In the windows of this electric clock, appear large figures to give the time of day in hours and minutes. A hidden light illuminates the numerals so the time can easily be read in the dark.



CABINET FASTENS TO DOOR. This home convenience is easily attached to any standard door. It opens when one side is pulled out and then revolves upon itself so it is out of the way when either closed or open. It adds to the available closet room with no inconvenience.

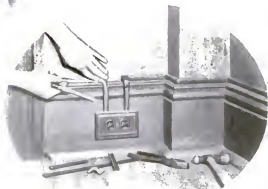


SAVES SOAP. A rubber suction cup holds the metal feet of this soap holder. When attached to tub or basin, it permits the water to drip off, thus preventing waste.



GUARDS FOOD FLAVOR. Odors in the refrigerator are controlled by this little device. It is hung or stood in the ice chest and prevents transfer of odor between foods.

NO TRAILING LIGHT CORDS. With the metal material shown at right, unsightly exposed electric wiring is done away with. All extension wires are safely and artistically enclosed.



NEW OPENER. To remove a jar top with this metal opener, just turn the handle. The flanges adjust themselves to grip the top. The strong leverage enables one to start a refractory top with little effort.



TOOTHPASTE TUBES CLOSED. The cap, seen at left, is designed to fit tubes, bottles and cans containing toothpaste, shaving soap and similar products. A twist opens or closes the hole in the cap.



TURNING A BATH TUB INTO A SHOWER. A new miniature shower is attached to the inside rim of the bath tub and connected to the faucet. When the water is turned on, the tubing throws a spray over bather's shoulders

TAKES STRING FROM BEANS. When a bean is drawn through this device, below, it is not only sliced into strips but the string is removed. A blade cuts off bean's end



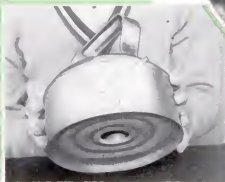
CREAM FLOWS FREE-

LY. In the bottle, illustrated below, there is a v-shaped depression in the side, that forms a partial obstruction. When the bottle is tilted for the purpose of pouring off the cream, this inner ridge holds the milk back and the cream will then flow freely, unmixed with the milk that is beneath it



SHIELDS ELECTRIC FAN

Danger of injury by the whirling blades of an electric fan is eliminated by the screen of fine mesh that is built around the blades of the new type of fan illustrated above. A lever at the back of the cabinet controls a mechanism that causes the fan to oscillate if desired



DUTCH OVEN FOR EASY COOKING. Food placed in this Dutch oven, and the lid tightly closed, is cooked with no loss of its original flavor or juices, it is said



CHINA DOG FOR ELECTRIC OUTLET

Three appliances can be attached to the unbreakable china dog seen above, thus doing away with the double plugs generally used

BOILS WATER QUICKLY. A hollow chamber in the center of the kettle, left, has an outlet pipe so the heat can rise and be distributed to all sides of the water at once, thus heating it with great rapidity

Weird Stunts with Aluminum in the HOME LABORATORY



MAKING ALUMINUM SHEETS SPARK

In the jar is a solution of baking soda in which aluminum sheets are immersed. When connected to lighting circuit and series-connected lamp the current will light the lamp and sparks appear on aluminum



On a clean sheet of glass, a word is written with a styptic pencil. When an alum solution is poured over the glass, crystals form rapidly and the invisible writing appears as white lines

OUTWARDLY aluminum is one of the least spectacular elements of the earth. Yet in the home laboratory, weird stunts reveal the strange properties that make it one of the world's most useful metals.

Although at one time worth its weight in silver, chemistry has made aluminum one of our commonest metals. According to leading scientists, its uses will continue to grow. Even now railroads, steamships, and airplanes make use of its physical qualities for lightness combined with strength.

Most important of its chemical properties is its unquenchable thirst for oxygen. Pure aluminum left in the air soon becomes coated with an oxide. It is this characteristic that makes it impossible to obtain the metal in its free state and also forms the basis of thermit welding (P.S.M., Aug. '33, p. 50) and many other modern processes in industry.

To the home chemist, this fast-forming oxide of aluminum offers the means of performing two novel electrical experiments. For the first, immerse two sheets of aluminum foil in a small jar or beaker containing a solution of baking soda (sodium bicarbonate). Connect one sheet directly to one side of the house lighting circuit and the other sheet through a series-connected lamp to the other side.

Then turn on the current. The series lamp will light and a brilliant display of sparks will appear on the surface of the two aluminum sheets. When viewed in a dark room, these sparks will dart and flicker like a swarm of bluish-white lightning bugs.

As the experiment continues, the sparking will grow less and less until finally both aluminum sheets will become incased in a ghostly, soft-white glow. Turning off the current, will stop the glow but it will reappear when the current is again turned on.

Soon, the series-connected lamp, that once was brilliantly lighted, will get dimmer and dimmer. Finally it will go out. A formation of oxide on the aluminum sheets becomes thicker and thicker until it forms a non-conducting wall that cuts down the current.

By substituting a strip of carbon or lead for one of the aluminum sheets, you can transform your novel glow cell into a simple liquid rectifier. Connected to an alternating current source, the cell will act as a one-way street, allowing only direct current to pass.

To test the current flowing through the rectifier circuit, you need only cut one of the wires and place the bared ends on a piece of white paper wetted with a solution of salt water to which a few drops of

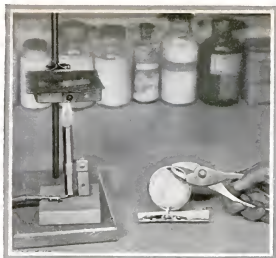
phenolphthalein solution have been added. If direct current is flowing, the paper around the negative wire will turn red. On the other hand, if the current is alternating, the paper around both wires will turn red. In preparing this experiment be sure the current is shut off when wire is cut.

While you are at it, you may as well make up a batch of this prepared paper for future use in your electrical work. Simply place the paper in the salt-water-phenolphthalein solution, allow it to dry, and place it in a tightly stoppered bottle. When you want to make a polarity test, tear off a piece of the paper, wet it, and bring it in contact with the two terminals of the circuit.

BEFORE breaking up your electrolytic rectifier, lift the two electrodes out of the solution and study their surfaces. The aluminum will be covered with a dull white film of oxide. It is this oxide that allows the current to pass only in one direction.

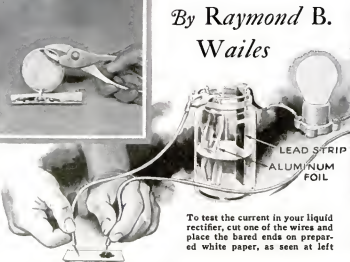
Around the home we find aluminum and its compounds in many of its varied forms. Most common, of course, is as a metal in the large assortment of kitchen utensils. However, when aluminum is combined with potassium, sulphur, and oxygen, it becomes potassium aluminum sulphate or alum—the main ingredient of the styptic pencil you carry in your shaving kit. Liquid deodorants for excessive perspiration also contain aluminum in the form of aluminum chloride. Incidentally, a good product of this type can be made by dissolving about a tablespoonful of the aluminum chloride in half a tumbler of water.

All solutions containing aluminum can



ALUMINUM PUTTY

Aluminum powder and sulphur mixed and heated over your gas burner combine to form a plastic solder or putty. Photo above shows apparatus used in compounding this putty



To test the current in your liquid rectifier, cut one of the wires and place the bared ends on prepared white paper, as seen at left



To demonstrate the purifying quality of aluminum compounds, fill two jars with turbid water. Stir one with a stypic pencil and let them stand for about eight hours. You will find the one stirred is clear, the other muddy

be identified by the jellylike precipitate formed when ammonium hydroxide (ordinary household ammonia will do) is added. As a test, make up an aluminum solution by adding a piece of stypic pencil or a crystal of alum to a tumbler of water. When the ammonia water is added, the liquid will cloud up as the thick aluminum hydroxide precipitate is formed.

Many aluminum compounds will react with ordinary water without the addition of the ammonium hydroxide to form the hydroxide of aluminum. It is this curious fact that makes it possible for us to purify turbid water simply by adding some compound of aluminum such as aluminum sulphate or alum.

This action can be shown in a striking way. Select two similar jars or beakers and fill one with water. Drop a pinch of dirt and some household cleaner into the water and pour the resulting liquid back and forth from one jar into the other until the foreign matter becomes well suspended. Then place an equal amount of

the liquid in each jar, stir one with a stypic pencil, and set them aside.

In about eight or ten hours compare the two jars. The one treated with the alum will be clear while the other still will be a cloudy, turbid solution. In settling, the jellylike precipitate formed by the addition of the alum will have carried all the dirt to the bottom of the container.

In the dye industry, this amorphous hydroxide of aluminum performs another important task. Many dyes will not enter the texture of some cloths directly. For this reason, the material is first soaked in baths of aluminum sulphate and ammonia water. This causes the aluminum hydroxide to be precipitated onto the fibers where it forms an adhesive for the dye. Chemically speaking, the aluminum hydroxide adsorbs the dye and holds it "fast." In the industry, substances used in this way are called "mordants," and the combination of the color and the aluminum hydroxide are referred to as "lakes."

Besides its many other uses in the home laboratory, ordinary alum serves as a particularly good substance for use in the study of crystals. Make a strong solution of alum in hot water and filter it. Then suspend a short length of string into a beaker of the hot liquid. As the solution cools, beautiful jewel-like crystals will form on the string. After several days it will resemble a necklace of clustered stones.

By using an ordinary stypic pencil, the amateur chemist can make use of the crystals of alum to perform a mystifying experiment in

magic writing. Words or sentences can be made to appear on a perfectly clean sheet of glass merely by pouring a solution (cold) of alum in water over its surface.

The sheet of glass is first prepared by writing some simple word on its surface with the tip of a stypic pencil. The writing can be so light that it will be invisible to the casual observer. However, when the microscopic particles of alum left by the pencil come in contact with the alum solution, they serve as a starting point for a rapid crystal growth. Picking up alum from the solution, these tiny crystals grow until the writing appears as a broad white line.

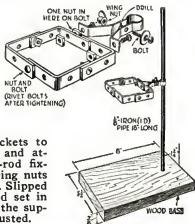
ALUMINUM powder such as is used in "aluminum" paints, fireworks, and flashlight powders is often put to another practical use that will prove a timesaver for the home experimenter. Combined with an adhesive mixture of the type obtained when celluloid is dissolved in acetone or amyl acetate, a so-called plastic solder is formed.

You can make another type of aluminum cement by heating the aluminum powder with sulphur. Mix one part by volume of the aluminum powder with three parts of flowers of sulphur or rolled sulphur (brimstone) and heat the mixture in an iron container. For small quantities around the home workshop, you can place the mixture in the top of a sleeve-top can and heat it over the laboratory gas burner. Be careful not to overheat it, however. If it should burst into flame, extinguish it quickly by smothering it with a sheet of tin.

Stir the mixture thoroughly during the heating. When it has become molten, pour it into a simple rectangular mold made by bending a narrow strip of sheet metal. To use the "solder" you have made, heat the stick with a match and allow the molten drop to fall into the hole or crack to be puttied. Bear in mind, however, that a metallic putty of this type cannot be used in all cases where soft solder is recommended.

Simple Flask Support

YOU can make a beaker support, for use with your burner, from four angle brackets, a towel-rod fixture, some bolts, and two wing nuts. Assemble the brackets to form a square and attach the towel-rod fixture and two wing nuts to form a clamp. Slipped over an iron rod set in a wooden base, the support can be adjusted.



A One-Man Show

with a

MAGIC HAT

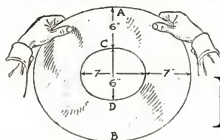
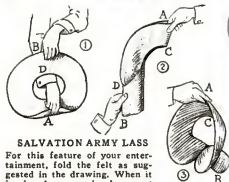


Diagram shows how the magic felt hat is made



FATHER OF HIS COUNTRY

To appear as George Washington, bring the edges of the felt ring together, as shown in the drawing above, and fasten them with clips. The hat is placed on the head as indicated in photo above and features properly adjusted



SALVATION ARMY LASS

For this feature of your entertainment, fold the felt as suggested in the drawing. When it is placed on your head you get the bonnet effect seen in picture. Arrange it before a mirror

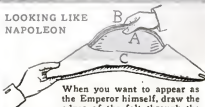


HAT FOR FRENCH PRIEST

The characteristic hat of a French priest is made by rolling the felt and drawing the edges through the hole. A white tie adds to the illusion



LOOKING LIKE NAPOLEON



When you want to appear as the Emperor himself, draw the edges of the felt through the hole, pull the ends tight, and fasten them with clips. The hat is then put on the head crosswise as shown and the coat collar turned up in the appropriate military form

HOW YOU CAN LOOK LIKE A CLOWN

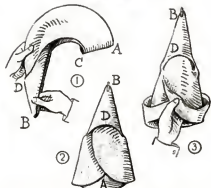


Diagram above shows how to fold the felt into a typical clown's hat. The point is fastened with a clip. A paper collar adds to the effect

Adding Earphones TO YOUR RADIO



JOHN CARR Describes Three Simple Ways of Cutting Out the Loudspeaker of Your Set So You Can Have Silent Reception

TO THE casual listener as well as the distance fan, earphones are a convenient accessory. Weak signals can be made audible and late programs enjoyed without the vibrating boom of a loudspeaker to annoy the neighbors who may wish to sleep.

Although few commercial receivers are wired with a headphone outlet, it is a simple matter to supply one. How it is done, of course, will depend on the arrangement of the receiver circuit.

If your radio is of the early type having its output transformer built into the chassis, a careful search will reveal two binding posts marked "loudspeaker" or "loudspeaker voice coil." By tracing the two wires connected to these terminals, you will find that they lead to the base of the speaker cone. To use earphones with such a circuit, merely disconnect the two speaker wires and substitute the tipped headphone leads. To return to loudspeaker reception simply replace the original wires.

To make the job permanent, wire a jack into the circuit to make the substitute connections. To use the earphones insert the plug. The loudspeaker will be cut out of the circuit automatically and the connections from the headphones substituted. The jack can be placed either on the receiver panel or at some convenient point at the rear of the cabinet.

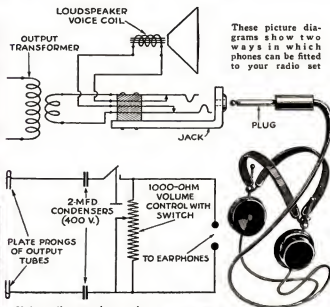
If you own a more modern receiver, you may find that the output transformer is mounted on one of the strap supports that hold the loudspeaker. If this is the case, the connections to the voice coil

leads must be made direct. There are no easily found terminals to allow a direct substitute connection.

First, locate the two voice-coil wires. These generally can be traced by the fact that they are smaller and more flexible than the field wires and lead directly to the "spider" at the base of the loudspeaker cone. Compare your speaker with the one shown in the photograph and you will have little difficulty deciding which wires connect to the voice coil.

When you have located the right wires, cut them, and wire in a jack as shown. This will give you the arrangement described above. Be sure, however, to connect in the jack in such a way that the speaker voice-coil circuit is broken when the jack plug is inserted and the earphones leads substituted.

IT IS in mantel and midget receivers that the amateur may have some difficulty locating the voice-coil wires. For this reason, this particular system is not recommended when the receiver parts are crammed into a small space. However, by locating the output tubes (or tube) you can connect a simple earphone circuit directly to the plate prongs (or prong) without touching the voice-coil leads. Of course, some means must be supplied to cut down the signal strength for the



Voice coil connections to the loudspeaker are being found, left. After this is done it is simple to wire in earphones



Voice coil wires on a dynamic loudspeaker are shown in this photo. They are readily identified by the fact that they lead to base of speaker cone

earphones and cut out the loudspeaker.

An arrangement of this type is shown in the drawings. In it a 500 or 1,000 ohm volume control and combination switch is used to cut down the output strength and two 2 mfd. condensers are inserted to protect the delicate earphone coils.

If the receiver has two output tubes, the circuit is connected to the plate prongs of the two tubes. On the other hand, if the set terminates in a single tube, one lead is looped around the plate prong of that tube and the other is grounded.

To use the earphones, simply turn the volume control. This will close the switch, reduce the volume to a satisfactory level, and cut out the loudspeaker.

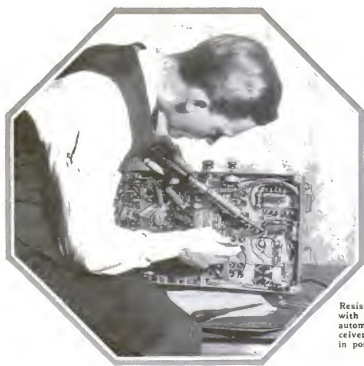
By using the connection shown at the left, a deaf person can obtain intense earphone volume without interfering with the loudspeaker reception. A 50,000 ohm potentiometer, connected across the earphone leads, will afford volume control.



Diagram shows how earphones can be wired for deaf person

Radio Sets

By
George H.
Waltz
Jr.



Resistor used in connection with a tuning light for an automatic volume control receiver, is here being placed in position in completed set

Novel Meters Indicate Accurately the Point at Which Reception Is Clearest

WITH the increasing popularity of automatic volume control, novel meters and flashing lights have made their appearance on the panels of many modern radio receivers. Known as "visual tuners," these recent arrivals bar distortion by allowing you to tune by sight rather than sound.

Where accuracy is concerned, ears are a poor match for eyes. Few people can judge the truthness of a note or the naturalness of a voice. Yet by means of a simple visible indicator, anyone can adjust the dial of a radio set as accurately as a musical expert.

At present, visual tuning arrangements fall into three general classes—meters, neon glow tubes, and shadow-lights. While differing from each other in physical appearance, their application to a receiver circuit is more or less the same. In each case, the device is connected to give an indirect measurement of the strength of the incoming signal, indicating silently the setting of the dial that brings the signal in with the clearest and greatest volume for maximum resonance.

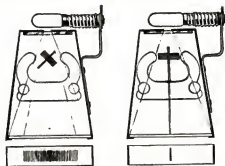
In reality, the visual tuning meter is merely a high-grade milliammeter of the high-resistance type placed in the circuit in such a way that it measures some current that varies according to the signal strength. A variety of meters for various ranges are available. Generally, they are designed to be mounted on the front panel of the receiver above or below the regular tuning dial.

Since the plate current of an amplifier tube changes with the strength of the signal being received, the plate circuit of the radio frequency or intermediate frequency tubes obviously is one place where the meter can be connected. Generally, this is what is done. The meter being inserted either in the common positive plate lead

of the A. V. C. (automatic volume control) operated tubes or in the single plate lead of the first A. V. C. radio frequency tube.

In either position, the meter will give a direct measurement of the current flowing and furnish, by the swing of its needle, an accurate indication of the signal strength.

Of course, the range of the meter used will depend on the number of tubes supplied by the lead and the current passing through them. The amateur radio builder



PUTTING
SHADOW-LIGHT
IN SET

Diagrams above show construction of the new shadow-light tuning device. At the right, photo of the shadow-light tuning indicator. It is mounted in a horizontal position behind a small hole cut in the cabinet



installing a tuning meter according to either of the two systems outlined in the drawings, can use a 0 to 5 mil. meter and, by placing a shunt across its terminals, adjust the exact range to suit conditions. A wide variety of meters is available in three or four different ranges. The meters, together with decorative escutcheon plates to be used when the device is installed on the front panel of a receiver, can be obtained from any of the larger radio parts supply houses for little more than a dollar.

Unfortunately, when equipping an assembled A. V. C. receiver with a tuning meter, it is sometimes difficult, because of the maze of wires under the chassis, to locate the plate circuit. When this is the case, another method can be followed. As shown in the drawings, the meter can be placed in the easily located cathode lead of the first A. V. C. radio frequency tube. By following the lead from the terminal of the socket, it is a simple matter to trace the wire back into the circuit.

A particularly good form of visual tuning arrangement is known as the neon glow tuning light. This is a long, slender tube containing three wire electrodes and filled with neon gas. Mounted behind a narrow vertical slit in the receiver's panel, it is connected into the circuit in such a way that a pinkish column of glowing neon gas rises and falls in the tube like the liquid in a thermometer, according to the strength of the signal. To tune a receiver fitted with this type of indicator, it is necessary only to tune the dial for the point that mounts the red ribbon of neon to its highest level. Responding to all incoming signals, the red column will dance up and down as each station is dialed.

The tube and the method of connecting it into an A. V. C. circuit are shown in the photos and drawings. Like the tuning meter, it responds indirectly to the signal strength. However, where the meter depends on the current in the plate circuit for its operation, the tuning light depends on the voltage.

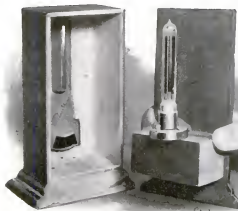
When installing a neon tuning light in an A. V. C. receiver, the first job is to locate the common B lead to the plate circuits of the tubes controlled by A. V. C.

Now Tuned by Sight.

This lead will be the one supplying the highest voltage to the radio frequency tubes. Cut this wire and insert a high-grade resistance (A) having a value equal in ohms to 18,000 divided by the number of tubes supplied by the lead.

Connect the anode of the tuning light to this B lead on the tube or circuit side of the resistance (A) and the cathode to the movable arm of a bleeder resistance used in the power supply. The tickler, or third lead from the tube, should be wired through a 250,000 ohm resistor to the negative side of the power supply.

As the signal is tuned in, the A. V. C. tube will cause the voltage across the resistance (A) to drop as the signal strength increases. This will boost the voltage across the anode and cathode of the tuning light and the pink glow in the tube will mount steadily, reaching its greatest height when the signal is strongest.



This auxiliary cabinet is used for the tuning light when it can't be mounted in cabinet

The shadow-light forms the third type of visual tuner in our general classification. This is a tuning meter in which a changing

shadow band takes the place of the moving needle. Mounted behind the front panel, its only visible part is a narrow strip or screen.

When the set is not tuned to a particular station, a broad black shadow is spread across the screen. But as the station is tuned closer the shadow band shrinks, the sharpest tuning being indicated when the shadow is narrowest.

Physically, the shadow-light consists of a horizontal permanent magnet surrounding a small iron vane and an aluminum shutter. In its no-signal position, this shutter cuts off entirely the light from a small lamp placed behind it.

Like the meter, the shadow-light is connected into the plate circuit. According to the current, the vane turns more and more and cuts off less and less of the light as the tuning becomes sharper.

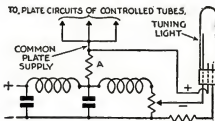
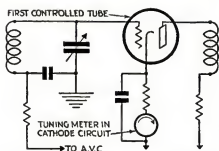
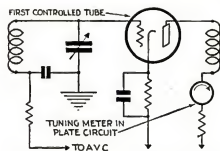


Diagram above shows how neon tuning light is connected and diagram, left, indicate manner of connecting tuning meter into the receiver

Lye Puts Satiny Finish on Aluminum Panels

BY IMMERSING them in a bath of lye, the amateur set builder can give his panels and other aluminum parts a satiny, professional-looking finish.

Unlike the emery method of finishing, the lye bath does away with tiresome rubbing and messy, oily rags. Merely make up a solution in the proportion of one full can of

household lye to one gallon of water and submerge the panel in the liquid. A ten-cent metal baking tin will serve as the container providing the panel is not too large to put inside it.

Of course, all tool work and drilling should be done before the final finish is applied. Then wash the panel thoroughly and place it back side down in the lye solution. To keep the metal free of the pan on all sides, rest it on four supports. In the set-up shown in the photograph, four small pointed rocks were used for this purpose.

The process is not particularly critical. In finishing the panel for the all-wave portable receiver described recently (P.S.M., Aug. '33, p.50), I found that a smooth, silvery-white finish was obtained when the aluminum was soaked for from ten minutes to a half hour. Of course, for larger panels a longer period will no doubt be required. If the panel is



After the aluminum panel has been dipped in lye water, it will look like this

left in the solution for two or three hours a black finish will be obtained.

Before you actually finish a panel by this method experiment with a few aluminum scraps, leaving them in the solution for various lengths of time so you can actually see the grades of finish that it is possible to obtain.—W.H.W.



New Gears Shift Themselves

GUS tells How Automatic Systems Take All the Hard Work Out of Driving and Make It Safer

BY
MARTIN
BUNN

GUS WILSON chuckled to himself as he climbed the steps to Jack Sheridan's diminutive front porch.

Frenzied early morning calls from Sheridan were a standing joke at the Model Garage and Gus wondered what it would be this time. "Probably an empty gas tank, a loose wire, or something else a baby could fix," he thought as he reached for the doorbell button.

But Gus never rang the bell. An ear-splitting crash of gears, punctuated with sputtered oaths, told him that Sheridan was airing his temper in the small garage adjoining the house.

Through a blue haze of smoke, the gray-haired mechanic could see Sheridan's car. The engine racing, it coughed and sneezed each time the gears clashed and groaned.

"Hey! What are you trying to do, wreck that chariot?" Gus shouted over the din. "Sounds like you're mixing up a load of concrete."

"I can't get the blamed car in gear," grumbled Sheridan as he tugged at the gear-shift lever. "The harder I pull, the louder it howls."

Gus motioned to Sheridan to slide over and climbed into the driver's seat beside him. With the motor shut off, Gus maneuvered the shift lever. "Shifts O. K. when the motor's not running," he said as he pushed in the clutch pedal, slipped the gears into low, and started the motor.

"There it's in with the engine running. Now let's see what happens when I let out the clutch."

The car moved forward as the clutch grabbed but when he tried to shift to second it was like pouring a load of pebbles into a coffee grinder. He slow shifted, he shifted fast, and he tried double clutching. Nothing seemed to make any difference. Finally, with a significant "grunt" he shut off the motor.

"Acts like the clutch bearing is either badly worn or broken," the veteran me-

chanic reported after a hurried look under the car. "I don't know for sure but I'll take it back to the shop and give it the once over."

Driving at a snail's pace, in low gear, Gus managed to coax the ailing car a few short blocks to the Model Garage.

Sheridan grinned broadly as the car coasted to a stop in front of the garage driveway. "All the racket I've been making shifting gears hasn't been my fault after all," he said.

"Not all of it," Gus agreed. "When a bearing starts to wear, the clutch drags and the gears in the transmission never stop turning. To force them in gear, is like trying to jump on an express train from the platform of a local station. You can't do it gracefully."

"I've never been one for a lot of fancy

business on a car but it certainly would help if they'd do something to make gear shifting easier," said Sheridan.

"How about an automatic clutch?"

"That's something like free wheeling, isn't it?" Sheridan asked as he found a comfortable position on the running board.

"Yes and no," replied Gus. "But one thing it does do is eliminate a lot of the tiresome movements in gear shifting. All you do

is lift your foot off the accelerator and move the shift lever. The automatic clutch does the rest."

"Sounds good, but I bet it adds a lot of complicated parts that are always getting out of order," put in Sheridan.

"Nope, you're wrong there. It's fairly simple," Gus told him as he opened the car door and pointed down at the floor boards. "All it amounts to is a fat cylinder and a piston mounted under the floor boards. The outer end of the piston is attached to the

clutch pedal and a pipe line leading from the intake manifold of the engine enters the other end of the cylinder through a valve connected to the accelerator pedal.

"When the gas pedal is released all the way, the valve is open, but as soon as any pressure is applied it closes. Naturally, when you take your foot off the gas, the intake manifold sets up a vacuum in the cylinder and the piston is drawn in. That pulls the clutch pedal down. When you step on the gas, the valve closes, shuts off the vacuum, and the piston and clutch return to their original positions.

"Simple enough," Sheridan agreed. "But how do you use it to shift gears?"

"It's just as natural as steering," Gus assured him. "To work the clutch you lift your foot off the gas, shift, and then step on the gas again. You see, it works right in with the usual way of gear shifting. The motor slows (Continued on page 89)



"Acts like the clutch bearing is badly worn or broken," Gus reported. Driving at a snail's pace, in low gear, he managed to coax the ailing car a few short blocks to the Model Garage for a more thorough inspection of the parts that seemed out of order

THE HOME WORKSHOP

MODEL MAKING : HOME WORKSHOP CHEMISTRY : THE SHIPSHAPE HOME

Boys Can Have a Carnival
of Fun with This Simply Built

High Striker

BY
GEORGE
S.
GREENE

THIS diminutive "high striker," to call it by the correct carnival name, will compete with baseball in interest when boys gather on the sand lot or in the back yard. It requires but little ground space and is just the thing, along with homemade "rides" and chutes, for staging a successful children's carnival.

In all but size the striker follows the construction of professional carnival and fair models. The similarity can be further carried out by offering big, long chocolate cigars for ringing the bell, if prizes of any kind are considered necessary.

A pine board $3\frac{1}{4}$ by $5\frac{1}{2}$ in. by 10 ft. is ripped down to a width of $3\frac{1}{2}$ in., and the narrow piece cut away is then screwed on to stiffen the back as shown in the small drawing at the left. After a coat of shellac has been applied, the score numbers are lettered on the board a foot apart, and the whole is then varnished.

A length of strong, polished brass wire is used for the track on which the counter travels. The wire is supported at either end with small corner braces, the tension being adjustable at the bottom by means of a threaded screw eye and nut as illustrated in the circle.

The counter is a wooden spool having a hole slightly larger than the diameter of wire used. At the top a metal gong is fixed by means of a long threaded bolt, which can be seen at the top of the large drawing at the left of this page.

Any long-handled wood mallet may be used. One may be made by boring or sawing a hole in three 1 in. thick blocks of wood and gluing them on the end of a heavy pole. The base of the striking board, shown in the large drawing, is of heavy construction, 12 in. wide and $2\frac{1}{2}$ ft. long. The striking arm, a strong, narrow board, is supported off center by two blocks screwed to the base. Cover the striking end of the arm with a piece of inner tubing, and place a small covered block immediately underneath so that the arm will have an inch of free play. Notches are cut in the other end of

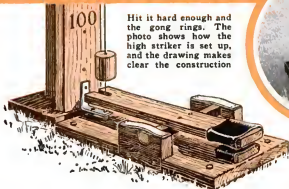
(Continued on page 78)



How the upper ends of the two slanting supports are fastened to the upright with bent angle irons and a bolt



The machine is regulated by adjusting the tension of the wire by means of a long screw eye with a wing nut



Hit it hard enough and the gong rings. The photo shows how the high striker is set up, and the drawing makes clear the construction

Tools and Materials I Use

WHEN I was a youngster on clipper ships, I made several models of the vessels on which I sailed. For material I had only what I could find aboard—a piece of deck plank for wood, unlad seizing wire, needles, pins and sewing thread from my ditty-box, and the like.

For tools I believe I persuaded "chips" to lend me an old saw and plane and, of course, I had my sheath knife and pocketknife. In addition, I made chisels from old files and three-cornered sail needles, and boring tools from hot wires, sharpened nails, and sewing needles.

When, many years afterward, I made my first model in New York for my own amusement, I reverted to practically the same tools, but soon found that I was wasting much effort, that a few tools would save time, and that with them I could do better work. Since then I have added quite a number of hand tools and some motorized tools, because working time is vitally important to me.

Some model makers seem to have every known tool; this is nice but not at all necessary. In fact, some of them seem to spend more time in selecting and finding the tool they want than in doing the job, and they need a boy to clear up after them.

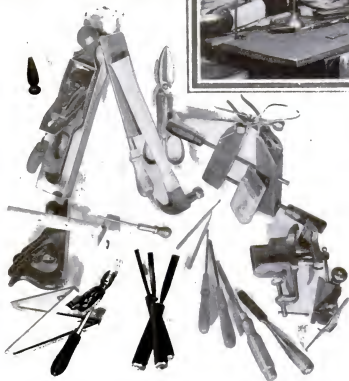
At the other extreme is the man who prides himself that "it was all done with a jackknife." This, of course, is just plain foolishness. The best work cannot be done with a knife only, and it is a waste of time and effort to try to build things without at least a few tools.

I propose, therefore, to list those tools I consider essential to good ship model making and then name other tools that I find valuable aids. It must, naturally, be remembered that every woodworker has his own preferences.

Now, suppose my workshop was burnt out and few dollars to spend. I would get the following, of the best quality:

It is on this bench that Captain McCann builds his beautiful ship models for Popular Science Monthly

About half of his ship model making tools are shown below. A large assortment is not needed, but the tools should be of excellent quality



Pocketknife, two or three blades, one ground to a slim point.

Panel saw, say 20 in., about 9 teeth to the in.

Block plane, small, say 3½ in. with 1-in. blade.

Fret saw, 12-in. bow, and blades.

Jeweler's hack saw.

Spokeshave, square-faced, wooden, with 1½-in. blade.

Rasp, 8-in. half-round cabinet, second cut.

Mill file, 6-in., second cut.

Needle or diesinker's files: three-square, round, and knife.

Bit brace.

Wood-boring brace bits, ⅜, 3/16, ¼, and ⅝ in. in diameter with 1 wood reamer 4 in. long, tapering from ⅜ to ⅝ in.

Twist drills, assorted, Nos. 80 to 42 (or 1/64 to 3/32 in.)

Pin vise to hold same, capacity, say, from 0 to .040 in.

Hammer, 3-oz. riveting, No. 0.

Three pairs of 5-in. pliers: flat-nose, round-nose, and diagonal cutting.

Nail set, 1/32-in. point.

Try-square, 9-in.

Boxwood rule, 2 ft. long, four-fold, boxwood.

Straightedge, 3-ft., brass or steel.

Some assorted small size C-clamps and spring clothespins with jaws cut down as shown in the drawings on the opposite page.

Tweezers.

Embroidery scissors.

Oilstone, 5-in. combination, fine and coarse.

Can of high-grade light machine oil.

Soldering iron, solder, and flux.

To make my stock of tools more complete, I should add the following useful, but not essential, tools:

Carpenter's 16-oz. claw hammer.

Crosscut saw, say 22-in., 9-point.

Ripsaw, say 22-in., 7-point.

Back saw, 8-in.

Screw drivers: one small, with ⅜-in. edge, and one from 8 to 10 in. long.

Gauges: one ⅜-in. straight shank, half-round; one ⅝-in. nearly flat gouge, and one ⅝-in. V-tool (or a small set of wood-carving tools).

Spokeshave, wooden, 5-in., with 2-in.

in Building Ship Models

By Capt. E. Armitage McCann

*Designer of many Popular Science
Monthly models and founder of
the Ship Model Maker's Club*



The remainder of Captain McCann's hand tools. In the column at the right are some sketches to illustrate points mentioned in the text but not clearly shown in the photos

radius, as shown in one of the sketches. Inside and outside calipers (inexpensive, spring type).

Vises: woodworker's bench vise and a parallel machinist's vise with clamp base. Electric soldering iron.

Cabinet scraper, or hook scraper.

Bench tool grinder.

Pliers, 6½-in., flat-nosed, side-cutting. Wood or iron jack plane, 14-in., with 2-in. cutter.

Smooth plane, 7-in., with 1½ in. cutter. Two adjustable hand screws, with, say, 6-in. jaw opening.

Carpenter's chisels, ¾, ½, ¼, and ⅛ in. wide, beveled, either tanged or socket. Side rabbit plane, 4-in. right-hand.

Hand drill, say 10-in. with chuck capacity from 0 to ¼ in.

Tin snips with 3½-in. or longer cutting edges.

Wood marking gauge.

A larger assortment of twist drills, two more pin vises, additional tweezers, and the like.

A 3/32- or even 1/16-in. chisel is handy. If you know a dentist, he will probably give you some worn ones that you can grind to suit. One chisel I use a lot is made from a ground No. 14 sail needle. Sewing needles can be had in many sizes, and if these are broken where they swell at the eye and are sharpened on the oilstone, they take the place, for most purposes, of small twist drills and are much cheaper. The pin vises will hold them. I use several pin vises to save shifting the drills, and they are slightly different in appearance so that I can distinguish them readily. A small crochet hook, with the hook ground off, makes a handy awl.

A small broach or two (a jeweler's



ROUND-NOSED PLIERS



SIDE-CUTTING



FLAT-NOSED



CLOTHESPIN CLAMPS



PIN VISES



NUT PICK WITH NOTCHED END



BELAYING TOOL



TWIST DRILL



SEWING-NEEDLE DRILL



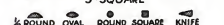
RADIAL SPOKESHAVE



JEWELER'S HACK SAW



FLAT



3-SQUARE



½ ROUND OVAL ROUND SQUARE KNIFE
NEEDLE FILES

English broach or reamer) is handy when you do not have exactly the right sized drill, say one No. 60 or both a 70 and a 50.

When rigging, I use a crochet hook a lot and also a belaying tool made from a bent nut pick as shown. The end of the latter is ground to a blunt chisel edge and has a nick filed in the middle.

With regard to other standard material, you will, of course, need fine and coarse sandpaper, say an assortment from No. 2-0 to No. 1½, and a sanding block faced with cork or other soft material. I find casein glue the best for large work, and for small work a tube of cellulose cement. Liquid fish glue is handy and will be satisfactory if, later, the joint is sealed with paint. One has always to remember in building a model that, bar accidents, it is to last forever.

Some ½-in. bank pins (called "lills") are almost essential; they can be bought at a large stationery store. A collection of small, thin brads is useful. Some glass-headed steel pins are also handy.

The ideal workshop has plenty of room with a good bench, racks for tools, and nests of drawers for small tools and parts, but good models have been made on a kitchen table supplemented by a tool box, or perhaps just a drawer and some little boxes for small parts.

The material from which models are made is most varied—a bit of this and a scrap of that. With the models described in this magazine, the most suitable materials have been listed in each case. Without this guide, one must judge by what the particular item is to look like and what one can best make it of, also taking into consideration what one has on hand or can easily get.

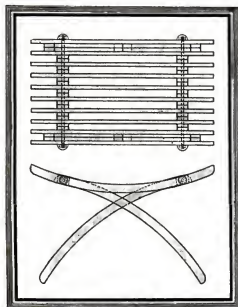
Such models as the pirate galley or the Viking ship can be made almost entirely from scraps, but a ship like the clipper *Sovereign of the Seas* requires a much more careful selection of wood, cord, chain, wire, and the like.

I find that clear white pine is the best for hulls, but knotty pine can be used if only clear sections of the boards are selected. All kinds of woods are best bought from the firms that specialize on wood for craftworkers because it is well seasoned and exact in respect to thickness. If wood from the lumberyard is bought, get the yard foreman to give you pieces from the bottom of the pile, as they are likely to be better seasoned, or buy wood as long as possible before you need it. If a model is hollowed and well glued, it is not likely to warp.

Clear white pine thicker than ¾ in. is sometimes hard to obtain, but pattern-maker's sugar pine is usually available in greater thick- (Continued on page 78)

Graceful Stool...

BUILT FROM COAT HANGERS



How the parts are assembled. Because of its light weight it is ideal for children's use



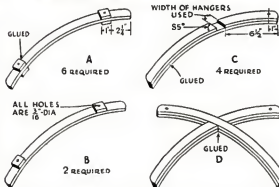
The finished stool. By the addition of a small pillow it may be made into a footstool

By Eric Munsinger

A UNIQUE, light, and handy stool can be made from ordinary wooden coat hangers. As its weight is only a little more than a pound, it makes an ideal playroom or nursery stool for a child.

The only materials needed are: Twenty coat hangers, some plastic wood putty, a 2-ft. length of brass rod $\frac{3}{16}$ in. in diameter with nuts and washers, and two contrasting colors of enamel or lacquer (such as light oak and dark mahogany).

Select the coat hangers for quality of wood and symmetry. Remove the hooks and fill the holes with the



The top consists of six parts like A, two like B, and two plain coat hangers. Legs D are made up of parts C

composition wood. From two of these cut twenty-eight 1-in. pieces and sandpaper them. Glue these in place on eight of the hangers as shown in the drawings at A and B. Cut four hangers as shown at C and glue these onto four others to form the legs. Cross and glue these together in pairs to form the double legs D. Then drill all the holes.

Now enamel four of the type A staves with the lighter of the two colors, and the legs and remaining staves with the darker color. Place all parts next to each other as in the finished stool, and measure the width. Cut two lengths of brass rod $\frac{1}{2}$ in. longer than this measurement, and thread the ends.

Assemble all parts, slide the brass rods through the holes, place washers on the ends, and tighten up with small nuts. Mold the plastic wood composition into neat hemispheres about the projecting ends of the rods and color them dark.

Clear-View Case for Small Ship Models Has Slanting Sides

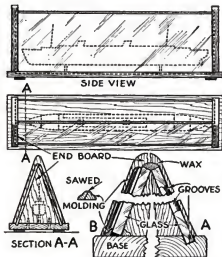
SMALL, delicate ship models such as the ocean liner *Manhattan* (P.S.M., Feb. '33, p. 63) and the U.S. cruiser *Indianapolis* (P.S.M., Aug. '33, p. 57) should have a case to protect them from dust and handling. Such a case can be made in a few hours at a cost of less than a dollar if the unusual clear-view design shown in the accompanying illustrations is followed.

The bottom and ends of the case are made of wood. The dimensions, of course, will depend upon the size of the model, but the drawings indicate the approximate proportions of length, height, and width for almost any liner model. The panes of glass may be mounted by one of two methods. If power tools are available, grooves can be cut in the ends and bottom to receive the edges of the glass as shown at A. When the work must be done by hand, the glass may be held by half-round or other suitable molding. For



the ends, cut the molding in half lengthwise; but for holding the glass at the base, cut it on a slant as shown at B.

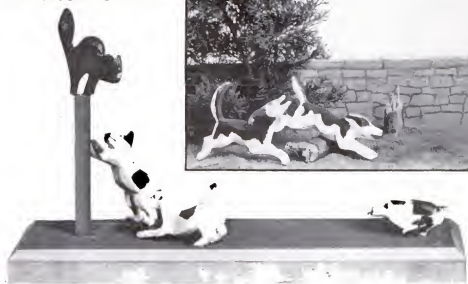
The model should be mounted on dowels or small turnings set in the base before the glass sides are put on. The trough formed by the upper edges of the two glass sides may be filled with wax or with a plastic wood composition. The addition of four square wooden feet will add to the looks of the case. A coat or two of varnish or varnish stain finishes the job.—W. TRUETT ROUSE.



Drawings showing the construction, and a photo of the case with the *Manhattan* model

Comical Animals Shaped from Blocks with Jig Saw Alone

Jig-sawed animals in scenic settings. Right: "A Hole in One." Below: "We Have Not Yet Begun to Fight." These gained a prize in our recent novelty Jig-Sawing Contest



"What is this jig-saw machine good for besides cutting little curlicues all over pretty pictures?" I asked myself, and then the idea struck me that everybody likes dogs, especially funny dogs or dogs doing funny things.

I grabbed a pencil, made a sketch, stuck it on a piece of wood, and sawed out a head, tail, two pairs of legs, and a body, and glued them all together. Not so good. It looked like almost anything except a dog. I decided it would look better made out of one piece of wood, so I made a new pattern and drew it on a block of yellow

poplar. In a few minutes I had a dog that looked almost as if he might wag his tail and bark. Spurred on by this first success, I made more patterns and more dogs.

By this time I had established a routine about as follows: I sketch a pattern on stiff paper, cut it out, draw around it on the wood, and saw it out. Now comes the real test of one's sawing ability. I stand the animal on end and saw out the wood between the legs. Next I tilt the legs up and take a slice off of each side of the nose, and also separate the ears by sawing

out between them. The tail is as thick as the body, so I saw a piece off of each side of it. By tilting the body sideways, I round off the corners. Sometimes it is necessary to make two cuts at different angles to get the right curve. I then cut a chip out of each side of the body to make the hollow flank, and cut in on each side of the neck to make it smaller than the head, afterwards rounding it up. I finish the job by taking light cuts off of all square corners. With a high-speed saw there will be no need of sanding after the sawing is done.

From single animals, I began combining groups with appropriate settings and making cats, rabbits, and other small animals to use with the dogs. Two typical scenic combinations are shown above. Jig-saw comics are as interesting to make as they are to look at after they are finished, and they will bring a smile to the most pessimistic face.—D. C. MARSHALL.



CONVENIENT HOOK FOR SQUARE-KNOT WORK

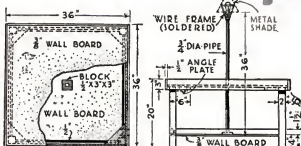
IN DOING square-knot work of the type described in various POPULAR SCIENCE MONTHLY articles, I have found that a rigid hook for holding the center strands is less convenient than one made as shown above from a 2 in. long split cotter key. Simply cut $\frac{3}{4}$ in. from one leg, bend this shortened leg slightly upward near its end, and file to a smooth, rounded point. Turn the longer leg downward and form into a loop or ring. About $\frac{1}{4}$ in. from the eye of the key, wind around a turn of brass wire, and twist or solder it securely in place.

Tie the center of a stout cord to the eye at the end of the longer leg and adjust the knot so that it will be on top. When the ends of this cord are tied around the waist, the cotter-key hook will hang in the proper position for easy operation. When tying a knot, slip the two center strands between the springy legs of the cotter, which will hold them as securely as necessary.—W. L. FAUROT.

PLAYTABLE KEEPS TOYS OFF THE FLOOR

MOTHERS who are tired of the everlasting task of picking up toys scattered all over the house will welcome a playtable like that illustrated. There won't be so many toys to pick up and it will reduce, to some extent, the laundry work on children's play clothes.

The table is of the simplest construction, and only four sizes of wood will be needed. The light, which is one that cannot be knocked over and is therefore entirely safe, makes the table useful on dark days and in the evening. The wire may have a small rubber hose slipped over it as an additional safety precaution. The rim around both the table top and the storage shelf keeps the toys from sliding or rolling off.—DONALD W. CLARK.



This playtable has several advantages. There is a rim to keep the toys from sliding or rolling off; a large shelf with a similar rim provides ample storage room; and the light cannot be accidentally upset

Ash Tray of Hammered Metal Resembles Viking Ship



You will rarely find a more decorative ash tray than this miniature Viking ship. It is made mainly of hammered sheet copper, but the prow, stern, and some shields are brass or aluminum for contrast. Both the patterns and assembly drawings are given at the right

This decorative little metal boat will appeal alike to the sailing enthusiast, the model ship builder, and the metal worker, for it serves as an ash tray. In design, it is a somewhat conventionalized model of a Viking ship.

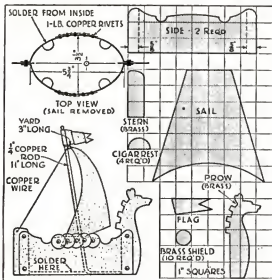
The entire model is made from sheet copper of about 16-oz. weight with the exception of the prow and stern, which should be of heavier gage and preferably of brass or aluminum for contrast. The

sides and sail are spotted or hammered all over, and the cigar rests are then bent up and soldered in place. The sides, prow, and stern are riveted together with copper rivets, and the bottom is fitted and soldered in place about $\frac{1}{4}$ in. up from the lower edge of the sides.

The mast, of $\frac{1}{4}$ -in. copper rod or tube and 11 in. long, is passed up through a hole drilled in the bottom about $\frac{1}{2}$ in. forward of the center. The lower part for about $1\frac{1}{2}$ in. is flattened, bent over, and soldered to the bottom.

The shields are 1-in. disks and may be of brass or aluminum if desired. The first three on each side should be riveted in place before the sail is put on, but the fourth is fastened with the rivets that hold the ends of the sail. The top edge of the sail is wrapped around a piece of heavy copper wire and wired to the mast.

After assembling, polish with fine emery paper or sandpaper, coat with thin shellac or clear lacquer, and paint designs on sail and shields. —LEE M. KLINEFELTER.



LETTER OPENER SHAPED LIKE DAGGER



The special features of this unusual paper knife are its resemblance to a Malay kris and its wire-wrapped handle

A paper knife or letter opener shaped like a Malay kris—one of those daggers with a wavy blade—will add interest to any desk. You can make it from scrap iron and bare copper or brass wire. Lay out the

dagger on the surface of the iron, which should be about $3/64$ in. thick, and cut it roughly to shape with a small chisel or a metal saw. Then smooth it up with a file. With a ball-peen hammer, pound the blade into shape, making it thin at the edges. Marks left by the hammering add to the attractiveness of the blade.

Smooth up the handle, drill two small holes near each end, and wind on the wire, using the holes to anchor the ends. These ends can be concealed by flattening them and pushing them back under the winding. A carved wood or bone handle may be substituted. —VERNON B. CASE.



NOVEL MAT MADE FROM WIRE COIL

By winding brass or copper wire in the form of a flat spiral like a pancake and then soldering the strands together, you can make a modernistic mat to go under flowerpots, vases, and dishes.

First construct a jig from two disks of thin wood or plywood as shown. Start the mat by winding a few turns of the spiral, leaving the center open; then place it between the disks, put a bolt through, and tighten the nut. You can now wind on the remainder of the wire without trouble, but be careful not to let the turns overlap because of too much tension. When the disk is of the desired diameter, solder the strands together through the slots in one of the wood pieces. —HERBERT WOOLSEY.

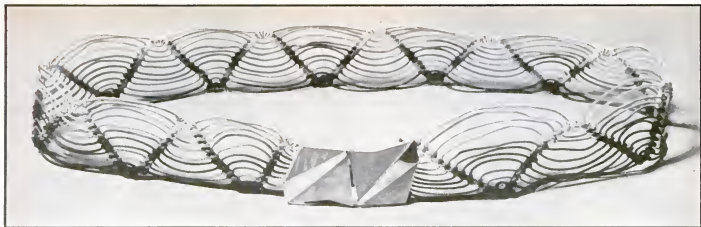


QUICK WAY TO ETCH IDENTIFICATION PLATES

ETCHED metal plates for use on drawers, luggage, tool boxes, and other articles are easily made from copper or aluminum. For etching the former, use dilute nitric acid; for the aluminum, a strong lye solution. Cut the plates to shape and immerse them in the etching bath until their surfaces are evenly affected, so that no polished areas can be seen. Wash thoroughly and dry. You now have a plate with a dull or matte surface on which you can inscribe any desired characters with a blunt tool such as a nail set. The marks look to be bright and shiny against the matte background. The inscription can be preserved by application of a coat of wax or other protective material, although this is not absolutely necessary. This method is quicker and easier than the ordinary way of leaving the metal bright and etching the design (see P. S. M., July '33, p. 61). —W. E. B.



The metal is first given a dull or matte surface in an etching bath, then marked with any blunt tool



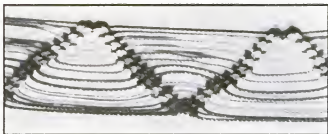
Smart New SPORT BELT

MADE OF KNOTTED STRING

By Kenneth Murray

THIS new style of knot-work belt is intended especially for wearing with sport clothes such as swim suits, linen slacks, and beach pajamas. Readers who have followed previous articles in this series will find the string belt simple and easy to make, and its design is distinctly modern.

A large choice of ten-cent celluloid buckles is available in the department stores. Obtain one of these and also suffi-



A part of the belt stretched out as it appears when in use. The complete belt is shown in the photo at top of the page

cient strong cord in assorted bright colors to make six 12-ft. strands and one 6-ft. filler cord. This completes the outlay for material.

Double each cord and loop it on the buckle in the manner shown. The same method was used in

making the wampum belt previously described (P. S. M., May '33, p. 63). Knot one end of the filler cord so that it cannot slip, and over it make a row of half-hitches with the other cords. The filler cord is then brought back to the other side, and another row of knots is made over it.

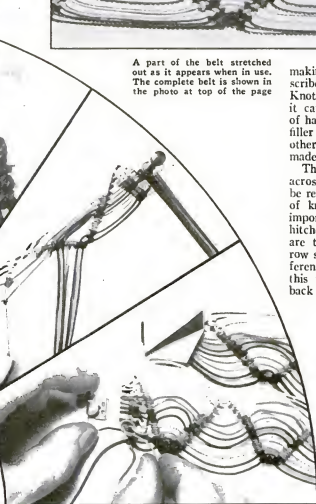
The filler cord is now carried back across the cords at an angle, which may be readily seen in the photographs. A row of knots is tied over it, but with one important difference: instead of two half-hitches being made with each cord, there are three. This will make the diagonal row sufficiently long to allow for the different angle at which it is knotted. In this manner the filler cord is zigzagged back and forth across the width with V-shape spaces of unknotted cord between.

End the belt with a straight row of knots like those made in the beginning. Attach the cord ends to the other half of the buckle with simple knots drawn tightly. After cutting the ends off short, place a drop of celluloid-base or so-called "household" cement on each knot.

When the string belt is used with a swim suit, it will readily dry without injury. However, it may be water-proofed by dipping it in paraffin dissolved in ordinary gasoline or naphtha.

THREE STEPS IN KNOTTING THE BELT

Doubled cords are looped on the celluloid buckle and two rows of knots made over the filler cord, which is seen coming from the left in the photo above. Rows of triple-tied knots zigzag from one side of the belt to the other, as in the next view. The third photo shows how the ends of the cords are knotted to the remaining part of the celluloid buckle



Simplest of all designs for a Boy's Auto

BY
H. SIBLEY

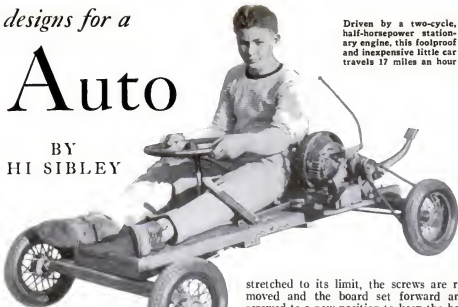
HERE is about the simplest little power wagon a boy can make—at least the simplest that will give satisfactory service. It is adapted to any of the small air-cooled engines of from half a horsepower up to three. There is no gearing and no clutch; the drive is direct to one wheel by V-belt, and to start the motor the passenger simply gives a shove and hops aboard.

As shown in the drawings, the wagon is equipped with a special flywheel brake and ignition cut-out, as well as a rear wheel brake, but both of these can be dispensed with if used where there is no traffic, for by stopping the engine it serves as a brake. The wagon can be further simplified by leaving off the steering gear entirely and using ropes to the front axle.

In the original wagon a standard half-horsepower utility motor is used, but a washing machine engine, model airplane engine, or bicycle motor can be utilized by fitting it with the proper pulley.

The wheels illustrated are standard toy automobile wheels with real balloon tires 2.5 by 12.75 in. Ordinary coaster wagon wheels will serve the purpose, although they will not give nearly as comfortable riding. Bicycle wheels are not at all satisfactory, even the small sizes, because they will not take a large enough axle and are not built for side sway, which is inevitable in a four-wheel vehicle.

General dimensions are given in the drawings on this page. Note the low center of gravity and very short wheel base, which make it possible to maneuver easily in limited space. The passenger sits at one side to balance the engine on the other, and this also allows him to make adjustments while running. The flywheel



guard, shown in the drawings on page 76, removes all hazard of getting clothes or fingers caught in the machinery.

The chassis frame is made up of 2 by 2 in. longons with a cross member at the rear of the same stock and a 2 by 3 in. piece at the front for carrying the kingbolt. A 7/8-in. board is set crosswise to support the motor and passenger's seat. Note that this board is fastened to the frame with screws and has cleats underneath. When the new belt becomes

stretched to its limit, the screws are removed and the board set forward and screwed to a new position to keep the belt tight. With a first-class V-belt only one such adjustment will be required.

The steel axles are laid in grooves made in the wood axles and secured with J-bolts made by cutting off the heads of 1/4-in. carriage bolts and bending a hook in the end. The grooves in both the wood axles should be off center—in the front to allow for the kingpin and in the rear for the anchor bolts.

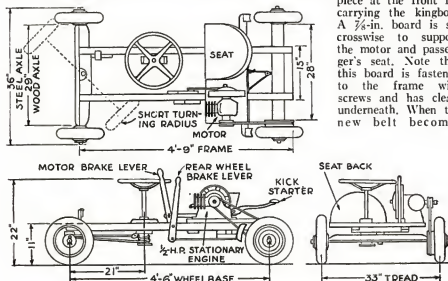
A sectional view of the front axle assembly is illustrated. In this connection bear in mind that while two-by-two's and two-by-three's are specified, the actual sizes of this material is considerably less when surfaced, but will be amply strong for the purpose.

The steering gear assembly is shown in the large perspective drawing. One point is important: have the cables approach the steering axle at equal angles, because the steering drum is off the center line and it is necessary to run the left cable through a pulley to overcome this and prevent slack. Use a good grade of sash cord and insert a turnbuckle to keep the cable taut at all times.

A 9-in. drive pulley is bolted to the hub of the left rear wheel, as shown. If there are grades to climb in your locality, use a 10- or even an 11-in. pulley. Note that the axle is stationary, and pulley and wheel turn freely on it.

While most small utility motors are provided with an ignition cut-out, the writer has constructed one in combination with a simple flywheel brake for greater convenience. This is illustrated in one of the small drawings and consists of a wooden brake shoe designed to be pushed against the flywheel by means of the hand lever marked *A* in the large drawing. The shoe slides along a wooden guide and is also slotted for a guide screw. A brass contact strip is wired to the magneto, and when the brake lever is pulled back, the brass touches the engine base and cuts out ignition. This type of brake and cut-out can easily be adapted to any design of motor.

The rear wheel brake is also highly efficient and easily constructed. It consists of wood shoes carried on a brake beam supported under the chassis and operated by a hand lever *B* through a sash-cord cable. A coil spring holds the beam forward when (Continued on page 76)



General assembly drawings of the boy's auto with over-all dimensions. These views show the extreme simplicity of the chassis construction, the wide tread, and the low center of gravity

ON THE KITCHEN TABLE

By Roger B. Stevens

While the (Continued on page 84)

(Continued on page 84)



Without any special equipment or previous practice in leather work, you can make overnight cases and other fine, durable luggage



A pigskin-covered case designed to hold target pistols and accessories weighing 20 lb. *At right:* The case opened to show target compartment and tray



The tray, also leather-covered, is hinged at the center and fitted with clasps so that it can be used separately as a small container.



The hinged joint is covered with a narrow strip of soft, spongy leather. *At right:* A corner seam



At left: A drawing of the assembled case, two sectional views, templates for cutting the leather, detail of hinged joint, leather knife, and correct method of sewing up the seams



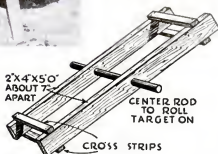
ARCHER ROLLS TARGETS FROM PASTEBOARD



Targets no larger than 2 ft. in diameter can be rolled under one's knee



Bigger targets like that at the left are started in the same way but finished on a wooden frame of the type shown below



STRAW target backs used for archery are expensive, wear out quickly, cannot be repaired when the centers have been shot away, and cannot easily be made at home even in the few localities where suitable rye straw is to be obtained. An excellent substitute, however, can be made from ordinary single-faced corrugated pasteboard, which is sold in large rolls for packing purposes. A target back of any size can be rolled from this material. The cost is low, it lasts well, and it can be repaired easily.

Saw the roll of corrugated board into 5- or 6-in. lengths and crush the strips as flat as possible by running them be-

tween the rollers of a wringer, by flattening them with a lawn roller, or in any other convenient way. If the target is to be no larger than 2 ft. in diameter, it is now necessary only to roll the strips as tightly as possible under your knee and bind with wire as described a little later on. It will improve the target to

brush the pasteboard heavily with a solution of sodium silicate (water glass).

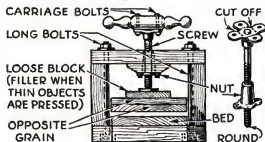
If a standard 4-ft. target is to be made, prepare a frame as shown in the drawing. Bore the center for a wood roller. It is best to start rolling the target under your knee (with the wooden roller in the center) until a diameter of about 18 in. has been reached and then mount it in the frame and continue rolling. Make the target from 4- to 6-in. oversize. As soon as the rolling is completed, place two No. 6 or 8 wires around the target as tight as possible and crimp them with pliers. Insert a small, hard roll of pasteboard in the center.

When the center has been hit so many times that it "leaks," loosen the wires, push out the damaged part, and roll and insert a new center. It may then be desirable to cut out a wedge-shaped segment from the old part of the target, starting at the new insert, and widening out to about 4 in. at the outer edge. Apply new wires and tighten until this space closes.—W. H. STEWART.

Coffee Table and Shop Press Constructed from Discarded Piano Stool

THE old revolving piano stool of painful memory—where little Johnny spent so many many hours of torture practicing the piano while the gang played baseball outside his window—had been collecting dust in the attic for many years, but it came to light when a search was recently made for furnishings to fit out a new basement "whoopie" room. By using the base of the stool for the legs and some scrap lumber for the top, the coffee table illustrated was assembled in short order.

The revolving top and the screw mechanism cluttered up the workbench till the idea presented itself of using the metal parts to make a press for linoleum block printing, bookbinding, gluing up flat materials, and the like. Now Johnny's revenge on the old stool is complete, for it has all been turned to profitable use except the circular seat—and even that may be valuable one of these days.—B.G.S.



The lower part of the stool forms the legs of a coffee table, and the screw mechanism is utilized in a press for special craftwork

Taking Telephoto Shots

By
Frederick D.
Ryder, Jr.

with your own
CAMERA

Fig. 1. Besides being invaluable for distant views, a telephoto lens enables you to take portraits from novel viewpoints, as at the right, when the camera alone would cause extreme distortion like that below

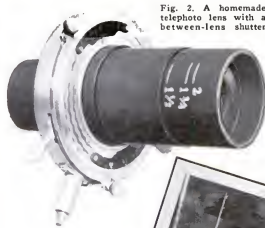


Fig. 2. A homemade telephoto lens with a between-lens shutter

more thrilling because the audience believed it had been taken from a much closer standpoint than seemed safe.

But when a cameraman uses a longer focus lens to increase the size of the image on the film, he does not use a true telephoto lens, even though he obtains a telephoto effect. The true telephoto lens is something quite different. It is an adjustable combination of two lenses, one convex or positive, the other concave or negative. By varying the distance between these positive and negative elements, almost any length of focus or desired magnification can be obtained.

The diagrams shown in Fig. 7 reveal the principle. The positive (convex) lens *A* is set in a tube which slides inside another tube

containing the negative (concave) lens *B*. Rays of light from the object are *converged* by the positive lens and would come to a focus at *x* if not interfered with by the negative or *diverging* lens. The latter, however, prevents the rays from forming an image until they have traveled to the point *y*. Since the distance from *A* to *y* is much greater than that from *A* to *x*, the image formed at *y*

Various types of equipment available, and an easy way to experiment with spectacle lenses

ILL bet that those big game camera-shooters can't get a cent's worth of life insurance!" exclaimed my wife as we sat in a movie and watched at close range a lion charging across an open field at us. "Imagine having to stand there and coolly crank the camera that took this picture—with that beast only a few yards away!" She shivered.

That my wife's thrill was shared by others had been apparent from the gasps of people near us, yet I happened to know that this particular picture had been taken from a perfectly safe distance with a telephoto lens. This does not mean that wild-life photographers take no risks, but the truth is that difficult or dangerous shots are often made much easier by fitting the camera with a sort of telescope.

In motion picture work this means

simply that the camera man has in his battery of lenses some of 5- or 6-in. focus as well as the ordinary 2-in. ones. Since the size of an image thrown on the motion picture film by a lens is in direct proportion to the lens' focal length, you can see that if you replace a lens of 2-in. focus with one of 6 in., you have multiplied the size of the image on the film by three—without changing the position of the camera. In other words, you have, in effect, moved your camera to a point only one third as far away. The large size of the charging lion on the movie screen was made

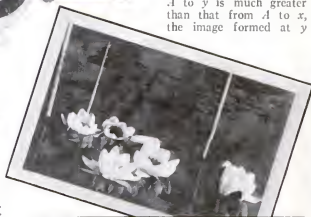


Photo courtesy Adam Archibol

Fig. 3. The water prevented taking a close-up of these lilies, but a telephoto lens caught them beautifully



will be proportionately larger than the one which would form at x if the negative lens did not prevent it. Both the size of the image and the focal length of the lens combination increase as the two elements are brought closer together. The magnification which can be obtained is, in fact, limited only by the length of the camera bellows that is available.

If you have a bellows camera that permits the removal of the lens, you can make and use a true telephoto lens that will give you as great a magnification of distant objects as the extension of your camera's bellows will allow.

The one I made is shown fitted to a small camera of the graflex type, which has a focal plane (curtain) shutter (Fig. 4). If your instrument has a between-the-lens shutter, the tube of the telephoto lens will have to be divided, one half being fitted into the front of the shutter, and the other half into the back (Fig. 2).

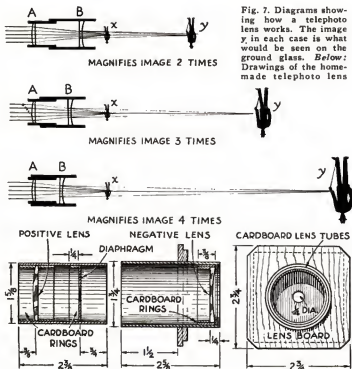
Figure 7 at the bottom shows the construction of the lens I built for the small graflex. You will find it easy to modify the plan to fit your camera.

The lenses are ordinary spectacle lenses, obtainable from any optometrist. It is essential to have them both of the same power or focus—some positive and one negative. The optician's description is, "Power, 8 diopters; with 1.25 curves inside, and 9.5 curves outside." If you ask for the lenses in these words, you will have no trouble in getting what you want. The lenses I obtained were 42 millimeters in diameter, but if you use a between-the-lenses shutter you will have to have your lenses cut down to the required size to fit into the tubes that fit your shutter.

This can be seen by glancing at Fig. 2.

Set your camera (still equipped with its regular lens) on its tripod, and focus it upon a distant tree or building. Mark this object's height upon the ground glass. Now remove the regular lens and substitute the tubes containing the telephoto lens elements. If you have a reflex camera with focal plane shutter, substitute the lens attached to a cardboard lens board as in Fig. 7. Then experiment with separating the lens elements (by pulling the front lens tube in and out) until you get a clear image of the distant tree or building on the ground glass.

Mark the height of the telephoto image on the ground glass and compare it with the height of the image made by your camera's regular lens. It will be larger. After marking a line on the front tube



where it emerges from the other, label this line with a figure expressing the number of times the telephoto's image is larger ($1\frac{1}{2}$, $1\frac{3}{4}$, 2, or whatever it is).

Now decrease slightly the distance between the lens elements by pushing in the front tube a little, and lengthen the bellows until you get another sharp image of the tree or building. Measure the height of the image as before, mark the point of emergence on the front tube, and label the mark with the figure that stands for the new magnification. By experimenting a little you can find the proper separation of the lenses to give the magnifications in even numbers or simple fractions.

You can add magnifications in this way until you reach the limit of the bellows extension. If you have a long-focus camera, you may be able to reach seven or eight times.

If you do not wish to build a complete telephoto lens as described, you can obtain the telephoto effect by placing two sliding tubes (the inner one containing a negative spectacle lens) upon the front of your camera's regular lens. This negative lens diverges the rays coming from the object before they enter the regular camera lens, thus lengthening its focus and making a magnified image possible from the same standpoint. A single supplementary telephoto lens of this type (Fig. 6) is manufactured and sold, but almost any negative (reducing) lens can be used in a pinch.

In addition to its advantages in giving larger pictures of distant objects, the telephoto lens has another use. It enables you to take (without distortion) pictures of a person whose arms or legs are extended toward the camera. This is illustrated in the two photographs of Fig. 1. Notice how distorted the lower view is in comparison with the upper picture.

A telephoto lens, built as I have described from spectacle lenses, will not give as sharp pictures as one made scientifically by an optician, but if the diaphragm opening is fairly small, as shown

in Fig. 7, very good pictures can be taken with it. The diaphragm opening in the tube is necessary only if you fit your lens to a focal plane camera. If you fit it to a between-the-lens shutter, you will, of course, use the iris diaphragm of the shutter itself, and can stop it down until the picture is sufficiently sharp.

Figure 5 illustrates a handy form of telephoto lens built to give as high as twelve magnifications. Figure 3 shows two pictures taken with it from the same standpoint. The lower one was made with no separation of the lens elements. The upper picture was taken with them separated to magnify about eleven times. This close-up could not have been obtained without a telephoto lens, as the water prevented a closer approach to the pond lilies. It shows strikingly the advantages of having a lens of this type.

SNAPSHOT SPEED Now Used Indoors

with New Fast Film, New Lights



In the upper picture note the blurring of ordinary movements typical of shutter speeds slower than 1/10 second. The picture at the right shows how such movements can be stopped at the higher shutter speeds now easily attained in indoor photography with the new fast Kodaks, Kodaflectors, and Kodak S. S. Pan Film.



How many indoor pictures have you missed because you couldn't use snapshot speeds on your subject? Nearly all indoor shots have required bulb or time exposures. For such exposures the camera cannot be held steadily in the hand, children won't stay still, the poses of grown-ups tend to become stiff and unnatural.

Now ordinary indoor photography has been speeded up more than 100 times—exposures of several seconds cut to snapshots of 1/25 of a second or less for lens speeds of f/6.3 or faster.

This advance has come with the introduction of inexpensive Photoflood lamps with an actinic equivalent of over 500 watts, the highly efficient Kodaflector, and lastly, Kodak Super Sensitive Panchromatic Film, which is extremely sensitive to electric light.

Many of the pictures you want most are of indoor subjects—why not ask your Kodak dealer to show you the new fast film, lights, and cameras that simplify indoor picture-making.



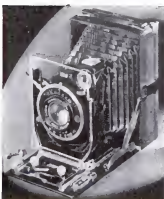
ALL THE PRINTS YOU WANT

A darkroom in your own home! You can develop your films—make as many prints as you want from each negative—all at little cost. A Kodak Darkroom Outfit No. 1 in any room which can be darkened is all you need. It's complete—includes safelight lamp, 3 enameled trays, developing and fixing chemicals, 8-oz. graduate, hard rubber stirring rod, thermometer, film developing clips, auto-mask printing frame, six blotters, and instruction booklet—also a copy of "How To Make Good Pictures." Cost, only \$8.75. See this outfit at your Kodak dealer's.

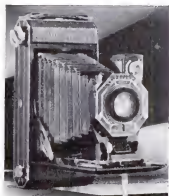


TWO FAST ACTION KODAKS

KODAK RECOMAR 31. (Right) One of the finest, most versatile of cameras. Has a fast f/4.5 anastigmat lens and an 8-speed Compur shutter working up to 1/300 second, with built-in self timer. Double bellows extension, eye-level wire frame finder, ground glass focusing back. Takes film packs, cut film, or plates. Kodak Recomar 31, 3 1/2 x 4 1/4, \$48. Kodak Recomar 18, 2 1/4 x 3 1/4, \$40.



KODAK SIX-16. (Left) The modern high speed roll-film camera. Compact, beautifully finished. Equipped with f/4.5 or f/6.3 Kodak Anastigmat Lens, Diodar Shutter with speeds from 1/10 to 1/100 second, exposure guide, duplicate shutter and distance scales making settings visible from top or front, and special easy loading features. Kodak Six-16, 2 1/2 x 4 1/4, with f/4.5 lens, \$30; with f/6.3 lens, \$17. See these new models at your dealer's, or send coupon for fully illustrated catalog.



*If it isn't an Eastman,
it isn't a Kodak*

TRY THIS COMBINATION

Here are the new film and lights that make indoor snapshots easy at any time, day or night. The new \$5 Kodaflector makes two Photoflood lamps do the work of nine. Kodak Super Sensitive Panchromatic Film, three times as fast as Verichrome under Photofloods, reaches snapshot speed levels at f/6.3 with one Kodaflector.

FREE!

TWO NEW BOOKLETS

A new booklet telling how to make snapshots indoors, and a new 56-page catalog, showing the latest Kodaks, home movie equipment, and photographic supplies. Send for your copies today.



Eastman Kodak Company, Rochester, New York.
Please send me the booklets checked below.

☐ New catalog of cameras and supplies

☐ New booklet, "Picture Taking at Night!"

Name.....

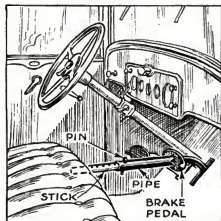
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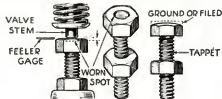
Helpful Hints for Motorists

Practical Suggestions for Doing Car Jobs Submitted by Interested Readers



Homemade Brake Stick

WHEN adjusting brakes you will often find it necessary to depress the brake pedal to some particular position. This is an easy one-man job if you use a simple improvised brake stick made from a scrap piece of pipe and the handle from an old broom. The broomstick should be an easy sliding fit in the pipe. Drill a hole $\frac{1}{4}$ in. in diameter in one end of the pipe as shown, and a series of $\frac{1}{4}$ in. holes spaced about 1 in. apart along the full length of the 18 in. section of broom handle. Then a small nail or cotter pin slipped through matching holes will allow you to adjust the telescoping rods to any desired length. In use, the brake stick is set to the desired length and wedged between the front seat and the brake pedal. A V-notch cut in the end of the pipe will prevent the stick from slipping on the surface of the brake pedal. A rubber cane tip will serve as a nonskid cap for the end of the broom handle. When not in use, the stick can be completely telescoped and stored in your repair kit.—J. H.



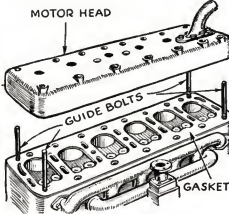
Grinding Tappets

WHEN car valves cause trouble even after careful adjustment, the difficulty generally can be traced to the top surfaces of the valve tappets. With continued use, the tappets wear away and a small pit or depression is formed where

they come in contact with the ends of the valve stems. This recess makes it impossible to adjust the valves accurately since the feeler gage will not show the actual clearance between stems and tappets. To remedy this, remove the tappets and grind or file out the pits, making the top surfaces slightly dome-shaped. With the valve stem resting on a flat surface, accurate adjustment can be made easily.—D. J.

Replacing Motor Head

IN REPLACING a cylinder head, it is often difficult to center the gasket and the head. This trouble can be overcome, however, by cutting the heads from four old cylinder head bolts and using them as guides as shown below. The headless bolts are screwed loosely in place and the gasket and head placed over them. The guide bolts then can be removed.—C. C., Jr.



Bolts from old cylinder head are used as guides in centering gasket and cylinder head

Radiator Cap Grip

A SOFT rubber fruit jar cover remover forms an excellent heat-proof grip for a radiator cap. Simply force it in place and leave it there. It is neat in appearance, affords a cool grip, and protects the metal cap should it accidentally be dropped on a concrete road or hard-surfaced garage floor.—F. W. B., Jr.



Rubber, used in removing fruit jar cover, is slipped over radiator cap to give cool grip



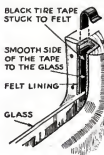
Danger incident to opening a car door is obviated by setting a mirror on door frame

Safety Mirror on Door

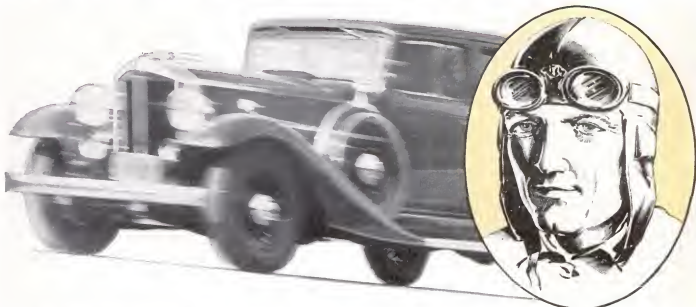
OPENING the car door next to the driver is risky business, especially on a crowded road. However, you can guard yourself and your car against possible injury by installing a small mirror on the upper edge of the window frame. Solder a small pocket mirror to a piece of fairly heavy wire attached to the frame by looping it around one of the window frame screws. The wire then can be bent to hold the mirror at the right angle. The mirror should be adjusted so that it gives a clear view of the road parallel to the car when the door is opened six or eight inches. Sometimes it is possible also to arrange the mirror to give a valuable oblique view through the rear window.—W. E. B.

For Silent Windows

ANNOYING window rattles caused by worn-out felt guide-strips can be stopped with a few lengths of ordinary friction tape. With the windows down as far as you can get them, force the tape against each side of the guides in the manner shown, the smooth side to the glass. The tape will serve as a soft liner to build up the flattened guides and hold the glass firmly in place in the grooves.—M. L. W.



NOT ONE BLOW-OUT IN GOLDEN PLY TIRES!



LASTED 3 TIMES LONGER IN GRUELLING HIGH-SPEED TESTS



Heat generated by internal friction separates rubber and fabric—starts "blisters," which grow and grow until BANG! A blow-out.



Remarkable new Goodrich invention resists heat—making the New Goodrich Safety Silvertown 3 times safer from blow-outs at high speeds.

"No blow-outs." "Lasted three times as long." First quality tires without the Golden Ply failed at one-third the distance . . . or less.

THAT WAS the sensational news that made our most skeptical tire men cheer. Gruelling high-speed tests—on the world's fastest track—proved the amazing stamina of the Golden Ply beyond a question of doubt.

Telegraph wires fairly burned with these marvelous reports: the safest tire ever built had been made at least 3 times safer from blow-outs at high speeds.

Heat . . . the unconquered enemy of tires . . . had been checked beyond the fondest hopes of the world's crack tire builders. *The Golden Ply had made the same quality tires last three times as long at gruelling speeds!*

Hundreds of thousands are flocking to this new kind of tire. Millions more will buy it when they buy tires. Because it doesn't cost a penny more than standard tires.

Today's high speeds generate terrific heat inside your tire. Rubber and fabric separate. A blister forms . . . *inside the tire*, where you can't see it . . . and GROWS . . . bigger and bigger, until . . . BANG! A blow-out! And your car shoots madly off the road.

To protect you from blow-outs, every new Goodrich Safety Silvertown has the amazing Life-Saver Golden Ply. This new invention resists intense heat. Rubber and fabric don't separate. Thus, blisters don't form. Blow-outs are prevented before they even start.

Remember, Goodrich Safety Silvertowns are the *only* tires in the world that offer the life-saving protection of the Life-Saver Golden Ply. Yet they cost not a single penny more than standard tires. Look up your Goodrich dealer's name in your Classified Telephone Directory. Have him put a set on your car NOW and be safe!

FREE! Handsome emblem with red crystal reflector to protect you if your tail light goes out. Go to your Goodrich dealer, join Silvertown Safety League, and receive one FREE. Or send 10¢ (to cover packing and mailing) to Dept. 158, The B. F. Goodrich Rubber Co., Akron, O.



Goodrich *Safety* Silvertown

Copyright, 1933, The B. F. Goodrich Rubber Co. WITH LIFE-SAVER GOLDEN PLY

ECONOMICAL PREHEATING OVEN FOR WELDERS

IN THE small welding shop, a good preheating unit will soon pay for itself in improved work and acetylene saved. It may be constructed without difficulty and at slight expense from odds and ends of material to be found around the average shop. Naturally, the conditions will vary in different shops and it is desirable to design the oven for the type of work the shop ordinarily handles, but a good arrangement for all-around general use is shown in the accompanying photographs.

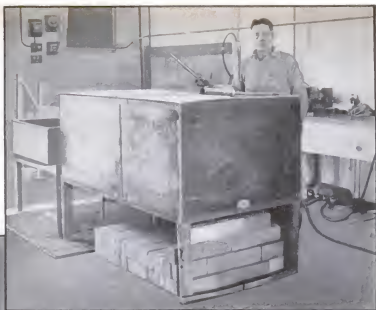
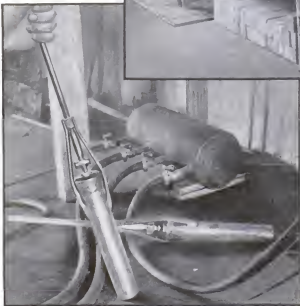
The oven, 4 ft. high, 4 ft. wide, and 8 ft. long, is made of light sheet steel welded in an angle-iron frame and supported on five legs of old pipe. The two cover sheets for the top are left loose, to be moved as required for draft. One side is left open. This side is, of course, bricked up when in use, only enough bricks being removed to enable the gas burners to be inserted.

For preheating small articles, the oven of a gas range is used. This is placed inside the oven just described.

For larger work a manifold is made by welding up both ends of an 18-in. section of 8-in. pipe and welding four 4-in. lengths of small pipe into one side. This allows the use of four burners. These are connected to four common gas valves,

The oven is made of sheet steel welded in an angle-iron frame and supported on five legs of old pipe. The far side is open but is bricked up when in use

The manifold and two of the homemade burners, in which common gas-range fittings are used, are shown below



screwed into the pipes mentioned, by means of from 6 to 10 ft. lengths of hose.

Each burner is made of a 12-in. section of 2-in. tubing, welded onto the gas fitting from a common range. The valve hinges are brazed fast, and a section of small pipe is brazed into the back of the valve section. It is on this pipe that the hose connection is placed. The adjustment nipple on each fitting is used when variations of pressure demand it. A light brace is welded to each side of the pipe and the main burner to stiffen the construction.—JOSEPH C. COYLE.

BORING TOOL MADE BY TIMESAVING METHOD



Boring tool designed so that the slot can be milled instead of drilled and filed by hand

THE special boring tool illustrated, which we use in a vertical milling machine, is designed so that there is no necessity for drilling and filing the rectangular slot for the cutting tool.

The steel body or shank marked *A* in the drawing is roughed out to within about 1/32 in. in diameter and beveled as at *B*. A slot *C* is then milled to the required dimensions. The end piece *D* is rough-turned and beveled as shown; then it and the shank *A* are set up in a V-block, butted together, and electrically welded. The beveled portions marked *B* and *E* are provided for welding purposes. It is important that the outside diameter of the end piece be the same diameter as the shank *A* so that when they are set up in

the V-block they will be automatically lined up for the welding operation.

After being welded, the tool is centered on both ends and finish-turned and polished on centers. Of course, no welding marks are visible after the tool is finished.

The final operations are to drill and tap at *F* for a 3/8 in. diameter hollow set screw, drill and tap at *H* for a draw bolt, and mill at *J* for a standard Woodruff key.—CHARLES C. TOMNEY.

HOW TO ADAPT A DRILL PRESS FOR TAPPING

FITTED up as shown in the photograph at the right, a drill press makes a satisfactory tapping machine. It not only speeds up tapping, but also does it more accurately and causes less tap breakage than when this work is done by hand.

A regular T-handle tap wrench with the handle removed is used in the drill chuck. The tap-wrench shank may have to be turned down to fit the drill chuck properly. The advantage of using a tap wrench instead of holding the tap directly in the drill chuck is that the wrench holds the tap at its extreme end and allows it to swivel slightly, which reduces the chances of tap breakage. The small diameter of the tap chuck as compared to that of the drill chuck gives added clearance for the tap.

The drill spindle can be made reversible for quickly backing up the tap by



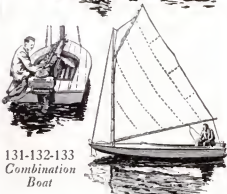
Tight and loose pulleys on the secondary shaft allow the tap to be backed out quickly

fitting the secondary shaft of the drill press with tight and loose pulleys driven by a belt from the main line shaft of the shop. The belt can be shifted by an arm fitted to the press as in the illustration above.—V. C. H.

SIMPLIFIED PLANS AND PATTERNS FOR BOATS

THIS is a good time to start building a boat, even if the summer is passing quickly away. The work will give you pleasant and profitable occupation for your week-ends, and you can get as much fun out of it as you will in using the boat next season. The designs below were made especially for amateurs, and simplified blueprints and full-size patterns are available for each of them. See the list on page 81.

128-129
Outboard Racer



131-132-133
Combination Boat



148
Motorboat-Rowboat



170
Folding Duck Boat



175-176-177
Runabout



211-212
Outboard Racer Class A and B

192-193-194 *Kayak*



"There's One Item
THAT SAVES YOU *Plenty*"

• • what's more, these new Champion Extra Range Spark Plugs are dependable and get extra power, speed and

acceleration out of any engine * * You'll also find them the most economical item on your bill because they'll pay their way several times over in the next 10,000 miles"



This patented shape means Champion EXTRA RANGE performance. Look for it

CHAMPION SPARK PLUG COMPANY • TOLEDO, O. • WINOSOK, ONT.

CHAMPION
EXTRA-RANGE
SPARK PLUGS



• Do your walls need an apology?

Have unsightly cracks or holes developed in the plaster... in walls, ceilings, corners, around the fireplace, electric outlets or sockets, over the sink or bathtub?

With Rutland Patching Plaster, you can easily mend them yourself and enjoy the satisfaction of seeing your walls in perfect condition. A few cents per room will buy all you need for a good, permanent job. In handy packages... just add water and use.

Rutland Patching Plaster is easier to use because it doesn't set so fast.

Takes paint or wallpaper perfectly. At your paint, wallpaper or hardware store. If cracks or holes are in portland cement or concrete walls, walks, driveways, cellar floors, etc., ask for Rutland Concrete Patcher instead. Made by Rutland Fire Clay Company, Rutland, Vt.



Rutland PATCHING PLASTER

For those who are thrifty but not careless



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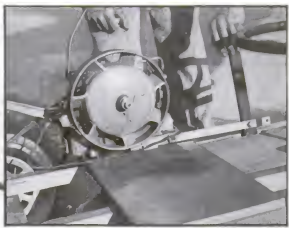
SIMPLEST DESIGN FOR BOY'S AUTO

(Continued from page 66)

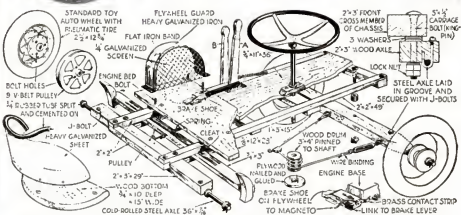


A rear view. The flywheel guard was not in place when this was taken. Note the brake shoe on the rear wheel

The V-belt pulley is fastened to the wheel with three bolts. Both turn freely on the axle



When the flywheel is applied, it cuts out the ignition



A partly broken away perspective drawing to make clear the chassis construction; details of drive wheel and pulley, bucket seat, flywheel brake and ignition cut-out, and kingpin assembly

HOW TO MIX YOUR OWN AQUARIUM CEMENT

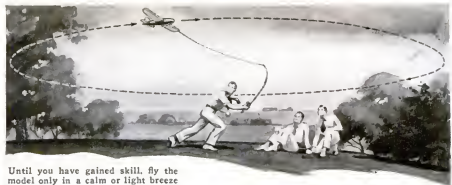
AQUARIUM cement of various types may be purchased, but when a large aquarium or several smaller ones are to be built there is some economy in mixing your own cement, especially as the ingredients are inexpensive.

The Bureau of Fisheries, Department of Commerce, has used satisfactorily for many years a cement made as follows: To 10 lbs. of glazier's putty add 1 lb. dry litharge, 1 lb. dry red lead, and 1 gill of asphaltum. Mix to a stiff consistency with boiled linseed oil and add sufficient lampblack to give a slate color.

Another well-known formula consists of

10 parts by bulk of plaster of Paris, 10 of fine sand, 10 of litharge, 1 part of powdered rosin, and sufficient boiled linseed oil to make a stiff putty. A third formula is as follows: Red lead 3 parts, litharge 7, fine sand 10, powdered rosin 1 part, and spar varnish sufficient to make a stiff cement.

In each case add the linseed oil or varnish little by little and mix the ingredients very thoroughly. If the putty should become too soft, merely add more of the dry materials as the exact proportions are not especially important.



Until you have gained skill, fly the model only in a calm or light breeze

Airplane Models

WHIRLED WITH FISHING ROD

at Mile-a-Minute Speed

By Laurence J. Lesh
Aeronautical Engineer and Inventor

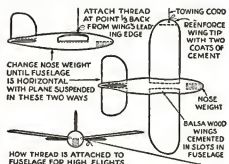


The author flew this balsa wood model with rod and line at 6,000 feet a minute

FLYING speeds of more than 6,000 feet a minute may be obtained with a properly designed airplane model if it is flown in a circle by means of a fine silk thread and a fishing rod and reel. Defects in design or balance are made apparent by erratic flight, and since the flight path is circular and the observer is always at the center, the action of the model may be checked much more easily than when a model is released for free flight.

While models of any size may be tested in this way, it has been found that one having about a 1-ft. wing span and a total weight of 1 oz. is suitable for very light silk thread and comparatively undisturbed air. Such a model may be flown indoors, but the experimenter is warned against the careless use of larger and heavier models. Obviously, the safest place for observers to group themselves is inside the circle, sitting down on the ground around the person flying the model, so that if the thread breaks the model will fly off harmlessly.

Models for this stunt are best built of solid balsa with an adjustable load of lead shot inserted in the nose and held in place by a plastic wood composition. The model should be tested while the wood composition is still soft so that the proper weight adjustments may be made.



How to construct and balance a model, and two different methods of attaching the cord

The design and adjustment follow usual airplane practice. A slight upturn or negative angle of the tail surface is necessary for stability at high speeds. The flying line is best attached to the wing tip and at a point where the model, when suspended by the thread, will bang with the body horizontal. Since the center of pressure of the wing will be at a point about one third from the leading edge, this gives us a good idea of where the flying line should be attached and how much lead must be used in the nose. Attaching a thread to a point on the fuselage about one third back from the leading edge of the wing will give us another check on the balance, since the body must hang horizontal in this test also.

Before attaching the flying line, it will be necessary to slightly reinforce the wing tip to which this line is fastened. A few extra coats of cement applied after the hole has been drilled, or a reinforcement consisting of a thin sheet of celluloid, will prevent the thread from pulling down grain through the balsa. A short piece of fine rubber band such as that extracted from the core of golf balls may be used as a connector; in fact, the model may be flown entirely on a long strand of this rubber with interesting results, but the tests will lack the speed and large diameter achieved with silk thread alone, as it has much less wind resistance.

Flying a model by this method in a wind is real sport and calls for skill and a degree of aerodynamic knowledge. Contests may be staged for highest speed attained as determined by timing the number of revolutions made in a minute and multiplying this by the circumference of the circle flown by the model.



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Remember that good polish not only makes shoes look better, but actually preserves the leather and makes shoes wear longer. For most shoes, paste polish is best, but for kid shoes we suggest Bixby's Liquids. If you want better shines for less money, clip coupon now!

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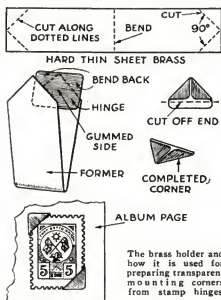
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never go back to ordinary glue or mastic. 25¢ a large tube at your stores. Free descriptive folder on how and where to use it. Write DU PONT, Dept. P-9, Wilmington, Del.

MAKING CORNER MOUNTS FOR "MINT" STAMPS

HERE is a helpful gadget for the growing army of stamp collectors. One of the difficulties of mounting what are known as "mint" stamps (stamps direct from the post office) is that regular stamp hinges cannot be used for sticking them in the album, otherwise the original gum on the stamp is destroyed and its value depreciated.



The brass holder and how it is used for preparing transparent mounting corners from stamp hinges

The commonest method of meeting this problem is to mount each stamp with the aid of two transparent corners in much the same way as a photograph is mounted.

For the well-to-do collector, the price of these corners is insignificant, because approximately 250 stamps can be mounted for a dollar, but it is much more economical to make the corners from stamp hinges with the device illustrated.—G. A. BENDER.

SEARCHLIGHTS FOR MODELS

NEAT searchlights for ship models can be made from the caps of discarded radio grid leaks. These are mounted as shown on a small binding-post nut by means of a Y-shaped copper wire.—R. H.



SIMPLE HIGH STRIKER

(Continued from page 50)

the striking arm and base to fit under the counter and around the brass wire track.

In setting up the striker, the base is held with long spikes driven into the ground. The upright is supported by two narrow boards with bent angle irons screwed to the ends as in the small drawing. At the top these supports are bolted to the upright, and at the bottom they are spiked to the ground.

After the device has been set up, the tension of the wire track may be adjusted so that a heavy hit by a young boy will send the counter well up toward the gong. If it is too sluggish, the track may be lubricated with vaseline. Only a very strong hit should be allowed to shoot the counter up far enough to ring the bell, but this can be regulated to suit the ages of the children using the high striker.

Wanted... from Model Railway Fans

short articles, hints, suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words.

TOOLS AND MATERIALS FOR SHIP MODELS

(Continued from page 61)

nesses. Whatever wood you use, be sure that the upper, or deck, lift is straight grained and of a good color, unless you are going to lay a separate deck.

For deck houses and pieces of that sort, I find whitewood (poplar) excellent; it cuts nicely and takes stains or paints well. I prefer staining this wood to using mahogany or oak, because with them the grain, being more prominent, is out of scale. Gumwood is also desirable for such purposes and is fine for small, strong pieces such as timberheads, catheads, and the like. Holly wood is even better for such purposes, but is a little harder to work. For all very small parts, or parts that require careful shaping or carving, boxwood is best because it is almost grainless; however, it has slight longitudinal strength. For anything to be bent, such as ribs, lemonwood (decage) is excellent. Strong spars can be made from this wood, though they are usually made from birch dowel sticks, which are tough and can be bought nearly to the required size.

In addition to wood, one will require several sizes of cord. Tight-laid linen cord is by far the best, because it lasts long and does not tighten and slacken so much with the weather. It can be bought from model supply houses or at fishing tackle stores. Where it is required black, it can be dipped in any water soluble household dye, but I prefer a dye that is soluble in alcohol.

Several sizes of wire are needed; these can be bought in small spools as required. Chain can frequently be picked up in the ten-cent stores in the form of locker chains, eyeglass chains, or bead threading chains.

The rest of the material is mostly odds and ends—sewing cotton and silk, pins, needles, scraps of brass, and, if you wish, celluloid or fiber for mast tops, caps, and similar parts.

In addition to such tools and material, you will need some tracing paper, card paper, thumb tacks, and dividers; and, if you are going to do any redrafting, a drawing board, T-square, triangle, and dividers. A flexible ruler and weights are a great aid, and one of my most constant companions is a pair of proportional dividers.

REVENGE MODEL SHOWN AT WORLD'S FAIR

SHIP model makers who visit the POPULAR SCIENCE Monthly exhibit on the second floor of General Exhibit Building One at the Chicago World's Fair will have the rare privilege of examining the original model of the Elizabethan galleon *Revenge*, which Captain McCann, author of the preceding article, designed and built for this magazine (see P. S. M., Apr. to Aug. '33 issues). It is an exceptionally fine example of craftsmanship by the man who has done more than anyone else to popularize ship model making. He is now at work on a new model for our readers.



"If that's catnip
I'm a caterpillar!"



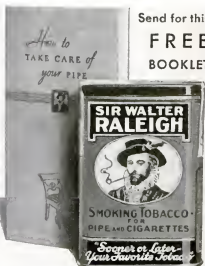
THE Colonel tried to be kittenish ... but the result was catastrophe! There is one tobacco that domestic pets (from wives to kittens) run towards, not away from!

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Model Locomotive

BUILT FROM JUNK

Runs Back-yard Railway

ALTHOUGH built from materials costing only \$12.35, this model locomotive hauls 350 lb. on a back-yard railway patronized by all the children in the neighborhood. It is 4 ft. long and weighs 80 lb.

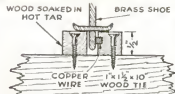
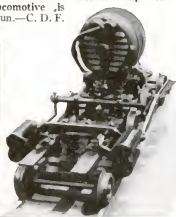
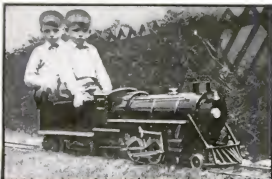
To drive the locomotive, an old washing machine motor costing \$3 was used. The speed, being 1,700 R.P.M., had to be reduced. The ideal way would be with worm gears, but in order to keep the expense down, the gears from the same discarded washing machine were used. This old washer, which cost 50 cents, furnished a set of plain spur gears, bevel gears, and pulleys, as well as shafting, bearings, and other parts. Three-speed reductions were made in this way.

The 5-in. drive wheels, pony truck wheels, and tender trucks were the only new castings made. The cab wheels and tender wheels

were taken from an old sliding door hanger. The speed is $3\frac{1}{2}$ miles per hour. To aid in starting, the coupler has a built-in spring.

The rails are $\frac{3}{4}$ in. square iron laid on wood ties, 1 by $1\frac{1}{2}$ by 10 in., soaked in creosote. The ties are placed $1\frac{1}{2}$ or 2 in. apart, and the rails are fastened to them with 1-in. finishing nails. Every other tie is all that is nailed, but even so, this would have been a tedious job without an electric drill. The curves are banked and there are the necessary expansion cracks, each connected with copper wires to complete the circuit.

The power is transmitted through a third-rail system. This had to be made with care so as to insure safety. The diagram shows the construction used. In wet or damp weather, the locomotive is never run.—C. D. F.



The locomotive in use, its power plant, and third-rail construction



BLUEPRINTS

to aid you in your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that

there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

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Ship and Coach Models

(Construction kits are available for some of these models. See page 80)

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YOU CAN PERFORM

with this homemade

Repulsion Coil



By *Kendall Ford*

ELECTRICAL experimenters who have seen large repulsion coils demonstrated in college or school laboratories have often wished to duplicate the experiments in their own workshops, but have hesitated on account of the expense involved. The repulsion coil to be described, however, may be built for a few cents and will provide no end of interesting and novel experiments.

The coil is connected to a transformer giving from 6 to 10 volts. Then, if an aluminum ring about 5/16 in. in diameter and 3/4 in. wide is placed on the vertical steel rod, it will be expelled over the top with considerable force when the push button is pressed. If the ring is dropped over the rod while the button is being pressed, it will oscillate upward and downward and finally come to rest about halfway up the rod. Placing one pole of a permanent magnet near the ring while it is suspended will cause the ring to oscillate rapidly. Reversing the magnet will cause the ring to rotate in the opposite direction. If the coil is boxed in, allowing only the steel rod to protrude, the effects will appear very mystifying to

The form upon which the coil is wound consists of a piece of fiber tubing $\frac{5}{8}$ in. in outside diameter and $1\frac{3}{4}$ in. long. Mount a fiber washer $\frac{1}{8}$ in. diameter on each end of the fiber tubing. One washer—the outer or lower one—should be drilled for the coil ends to pass through. Thread the end of a 12-in. length of $\frac{1}{4}$ -in.

screw-stock steel a distance of $\frac{5}{8}$ in. and screw one hexagon nut into place. Place the coil form over the steel rod and fill the space between the rod and fiber tubing with pieces of No. 20 gage soft iron wire $1\frac{3}{4}$ in. long. The last few pieces of iron wire should be forced into place in order to secure the form upon the steel rod.

Place the end of a length of No. 22 double cotton covered wire through the inside hole in the washer and wind eight layers upon the form. The winding can be facilitated by placing the rod in the chuck of a hand drill, as shown in one of the photographs. Shellac the coil and cover with a layer of heavy paper to give a finished appearance.

Mount the coil on a wood base as shown in the drawing. It will be necessary to countersink the mounting hole in the wood to provide a space for the hexagon nut next to the coil end. Mount the push button, which consists of two strips of No. 26 gage spring copper and a piece of 5/16-in. dowel, in the approximate position indicated in the drawing. Provide terminal screws and connect up as shown. Place rubber-headed tacks at the corners underneath the base.

Since the layman generally thinks of an electromagnet as having only the power of attraction, a brief explanation of how the coil operates may be of interest. When an alternating current flows through the winding of the coil, the magnetic field produced flows upward through the core one instant and downward the next. The changing magnetic field flows through the aluminum ring and induces a current in it that is opposite to the current flowing in the coil. The current flowing in the



The completed repulsion coil and an easy method of winding the wire with the aid of a hand drill. The coil may be concealed in a box, if you prefer.

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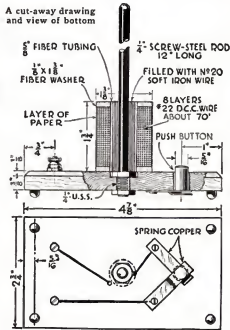
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ring sets up a magnetic field which is, at any instant, opposite to the field produced by the coil winding, consequently the ring is forced away from the end of the coil.

A cut-away drawing and view of bottom



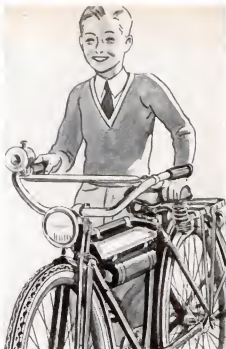
HINTS ON REMOVING OLD WALL PAPER

For those home workers who do their own wall papering, the following suggestions may save considerable labor. In repapering rooms, the old paper should always be removed to make a good job. A great help in this matter is to add saleratus or baking soda to the water before applying it to the walls. About a tablespoonful to the gallon is about right. The water should be hot so that it will penetrate better. The usual way to apply the water is with the paste brush, but this is always a more or less sloppy job. A far superior method is to use an ordinary garden sprayer designed for applying insecticide. These hold about 2½ gal. of liquid and may be fitted with brass extension pipes that will reach very close to the ceiling and enable it to be sprayed from the floor. An average room requires only about five minutes to spray, including the ceiling. It is left until the water is absorbed and then given another spraying. Usually two treatments are sufficient, and the paper peels off easily. This is a very easy, quick and clean method.

To remove the ceiling paper, it is well to have two supports on which a heavy plank is placed. Then the worker mounts this and, starting at one end with his scraper, walks to the other end of the plank. This takes off a whole strip at once and is a simple way to do this awkward and annoying overhead job.—H. CALDWELL.

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DAVITS for the POPULAR SCIENCE MONTHLY model of the U. S. S. Texas can be made from ordinary fishhooks. A portion of the hooked end is cut off and the davit is screwed to the ship's side through the eye at the other end. It is then a simple matter to tie and glue the threads from which the boats are suspended. As battleships customarily carry their boats swung outboard, the davits should be set facing outwards.—E. TROUP.



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MICROSCOPE MOVIES SEEN ON A SCREEN

(Continued from page 43)

edge of the arc mounting block. One of the screws or bolts for holding each coil in place can be used as a terminal for the current supply. To protect the upper edge of the wood support from the intense heat of the carbon arc, sheath it in metal or asbestos. In fact, you can improve the construction greatly by substituting a piece of sheet asbestos for the wood.

As indicated, the electrical circuit consists of a suitable resistance, either fixed or variable, placed in series with the arc and the house lighting circuit.

WHEN you have completed the sheet metal housing for your arc light and have fastened it in place with a single pivot bolt, in such a way that it can be lifted free of the carbons, you are ready to make the final adjustments on your micro-vivarium.

Fill the cooling cell with tap water, plug the circuit into the house supply, and adjust the carbons for the best arc. Be sure that the bright point of the arc lines up with the lens and aperture. Then, remove the condenser lens (B) nearest the objective and slide the other condenser (A) back and forth on its rail until the spot of light striking the back of the aperture plate is as bright as you can make it.

Leaving the lens A in that position, replace lens B and adjust it until the spot again reaches its maximum point of intensity. The beam of light passing through the condensers, the cooler, and the aperture then should be a brilliant spot on the lens of the objective.

Having made these final adjustments, you are ready for your first magic trip through an enlarged microscope land. Although the ordinary specimens in your slide library can be used in your micro-vivarium, the subjects they contain are dead and present none of the beauty and motion of the living variety. Besides, you can make up special aquarium slides that will show you the living things.

If you were successful in your attempt to capture the wily Volvox Globator described in a previous article (P. S. M., July '33, p. 36), you can prepare him as a subject for your first microscope movie. All that is needed is a glass slide of the type having a shallow well ground in its upper surface and a small cover plate. Aquarium slides are simpler to assemble than the cold storage variety. Place the water containing your actor in the well of the slide and slip the tiny cover glass into place. Capillary attraction will hold it in place without the aid of cement. Then place the slide under the aperture plate clips and adjust the objective lens until a sharp image of your captive is thrown on a white screen which is about six feet from the projector.

YOU can make up your miniature projection aquariums as you need them. The well slides and cover glasses are so inexpensive you can keep a supply of them on hand. You can even store your specimen slides from day to day without killing the organisms they hold. Simply slide the cover plate down a trifle so the rim of the well is exposed. A drop of water taken from the same source as the original placed over the opening each day will keep your captives alive and healthy.

NEXT month we shall be back again in the woods, on the trail of the amazing mycetozoa, the moldlike organisms found on decaying trees. Varied, fascinating, and baffling, these organisms, seen under your microscope, will open to you an entirely new world where the life forms are neither vegetable nor animal. In the October issue, the manner of finding and studying these strange creatures will be described and no microscopist will want to miss this revealing article.



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WILLIAM M. DOLAN, at sixty-five, found himself in the class of men "too old to work." He had been employed as an electrician all his life and once owned a business of his own. The depression ousted him from a job he had considered secure for life and he found himself out in a different world, with just a few dollars saved, no relatives or friends to whom he might turn and unable to do any strenuous labor. Day after day he did what thousands of other men like himself were doing; tramped the street from morning until night for a job that never seemed to materialize.

As a youth he had been keenly interested in photography. As he advanced in years this interest changed from a mere novice's thrill over taking a good snapshot to a desire to understand the mysteries of photographic technique.

Suddenly his mind turned to that hobby of his. He recalled having read once that newspapers and magazines buy photos if one knows just how to take them.

The next morning he called on a newspaper friend and explained the situation to him. "On your way home," said his newspaper friend, "stop off at the library and look at a few copies of trade magazines." "What I mean," he explained, "is magazines that go to bakers, butchers or plumbers. Read them. Look at the photos and then go out and take photos that tell the same story."

DOLAN went home that evening and did what his friend had suggested. He went over the magazines and he found out for the first time in his life that each magazine tells everything in its particular field that might interest a reader. In the baking magazine there were pictures of new plants that were just opening; pictures of bakers who had made money with some idea or other. In the plumber's magazines, pictures of conventions, local gatherings and news.

Dolan recalled a large baking plant that was opening a few blocks from his home. The next morning he grabbed his camera, went down there, took one shot of the outside, one of the interior and luckily enough the builder and owner were there and he asked them if they would mind being snapped in front of the plant. They didn't mind, and Dolan got his pictures. He developed and

(Continued on page 87)

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BEATING DEPRESSION AT SIXTY-FIVE

(Continued from page 86)

printed them and then sent them to the baking magazine he had been reading the night before. Three days later he received a check for twelve dollars and a letter from the news editor asking for more.

Dolan averages from twenty to thirty dollars a week by taking pictures of unusual window displays, new plants, new stores and men who have made good progress in their particular line during the depression.

"The equipment is inexpensive," Dolan told me recently. "Any man can buy a good used camera cheaply. Later, when he begins to make money, he can trade it in for a new one. Developing and printing prices have fallen and it's cheaper to have someone else do the more important and messy work. It gives a fellow more time to go around and get more pictures."

Dolan is now taking pictures of the oldest houses in his home town and expects to sell them to a local newspaper for its anniversary edition.—J. C., New York.

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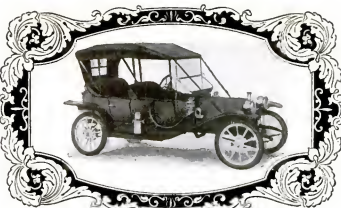
"FAIR EXCHANGE" FILLS FURNITURE NEEDS



THERE are many ways of solving the depression problem. Some find the old solutions serve, and some invent new ones. One of the most practical and successful new answers is "The Fair Exchange" on Beacon Hill in Boston, a combination of antique shop, secondhand furniture market, apartment furnishing bureau and idea headquarters.

"The Fair Exchange" came into being last fall when Margaret Stephenson and Lee Sheehan were in the throes of finding furniture for their new apartment. It was so difficult to find cheap furniture that they suddenly wished there were somewhere they could go for help. With the wish an idea came into being. Why not create just such a place themselves, where people who were having furnishing difficulties could rent attractive furniture cheaply?

So, in the teeth of the depression, and disregarding all advice to the contrary, Miss Stephenson gave up her job in a law office in order to open a shop; Miss Sheehan kept her job in an insurance office so that the concern would have a little money for operating expenses. They rented a small shop, into which they put a few personal possessions, a few simple antiques, and then started out to look for attractive, cheap furniture suited to the special (Continued on page 88)



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NEW GEARS THAT SHIFT THEMSELVES

(Continued from page 58)

down when the shift is made and speeds up as the clutch begins to take hold."

"By the way, Gus, that reminds me. A fellow said something the other day about a new automatic gear shift that's just come out on a new car. Is there anything in it?"

"Sure, if you don't like to shift gears," Gus replied. "The general idea is not so new. In my younger and palmer days, I had an automatic gear shift on my car. You had to push buttons to change gears."

"Do you have to push buttons on the new one?" Sheridan asked.

"NO, THE new one is really automatic. It does most of the work of gear shifting for you and does it better than you could do it yourself. All you do is step on the gas and centrifugal force does the rest."

"Centrifugal force?" Sheridan repeated in a puzzled tone. "What's centrifugal force to do with it?"

"Plenty," Gus said. "The whole idea is based on it. A set of governor weights fly out and work a clutch that throws the car into high gear when it reaches a certain speed. Once you start the car, the governor weights do the rest. When you slow down, the weights drop back into place and the car runs in low. When you speed up, it shifts back into high automatically. It selects the gear that's best for the speed and power needed."

"Only two speeds ahead?" Sheridan interrupted.

"Only two in the regular driving range," Gus explained, but by turning a small gear-selector handle on the dash, you can obtain an auxiliary low range having two automatically selected gear ratios. Actually that's four speeds ahead, but only two are used for regular driving. The two others are for tough pulling."

"How about the clutch? Do you have to use it at all?"

"Only when you start. When you get in the car you start the motor with the usual way, push in the clutch pedal, and move the selector handle from neutral into the running position by pushing it in. Then you let out the clutch, step on the gas and forget about the gears. To stop, you push in the clutch and step on the brake. Simple, isn't it?"

"I'll say," replied Sheridan enthusiastically. "How about reverse?"

"Simply move the selector handle after pushing in the clutch," said Gus.

"Can you 'free wheel' with an automatic transmission?"

"NOT with that type, but an automatic gear-shift arrangement just developed in Detroit has the free-wheeling feature. Like that clutch I was telling you about a few minutes ago, it's operated by a vacuum."

"It has a master vacuum clutch and three separate vacuum gear clutches that are controlled by a centrifugal governor attached to the main drive shaft. As the driver presses down on the accelerator in starting, the intake manifold vacuum decreases. This engages the first transmission clutch and then the main clutch. The car is then in low. When the car speeds up, the governor shifts to the second gear position. Then the driver just takes his foot off the gas and steps on it again slowly. That engages the second gear clutch. To shift to high, he just does the same thing all over again."

"Goah, in a few years an ordinary car like mine will be an antique," grinned Sheridan.

"Just the same as your car makes a 1925 model look like an antique," Gus agreed. "It's been that way in the automobile game as long as I remember—and driving has been getting easier and safer all the time."

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MOVIE ANIMALS TRAINED BY TRICKS

(Continued from page 31)

some sixty species of birds and animals, I found Halitosis, the hooting owl. It seems that a trainer discovered the owl would hoot during the day when he said to him, "Son, you've got balitosis!" Next day Kerr walked up to the bird's cage and after some preliminary remarks, said, "Halitosis, let's bear you hoot."

"Hoot, hoot, hoot!"
Gradually Kerr dropped the name and now the owl hoots on command. Sometimes he needs a little coaxing, but eventually he will hoot. I can testify to the fact.

Believe it or not, skunks are among the most popular actors for certain types of pictures, particularly gag comedies. Skunks train exclusively on raw meat. One or two around Hollywood really seem to have a glimmer of intelligence and will heed spoken commands grudgingly. Their bits consist principally of throwing a roomful of people in an uproar by following a trail of meat through a window or digging down through dirt covering of a box toward a rat.

KERR worked several years with Sammy, an American eagle, hoping the bird eventually would become amenable to simple directions. Always, however, he treated the bird with great respect, fearing his powerful talons. At last came a call for a vulture. Now vultures are rare birds in the United States. They are costly to import, difficult to keep healthy. So Kerr and an assistant took Sammy from his perch and in a few minutes, working with only a pair of scissors, so trimmed the feathers on his head that he was able to double for the vulture.

Sammy's bistrionic abilities are confined largely to screaming. He literally shrieks when Kerr acts as though he were about to attack the bird. The other day Kerr tied Sammy to a high beam to keep him from flying away. But, when the trainer started down a nearby ladder, Sammy grabbed Kerr's wrist, his talons sinking deep into the flesh. Anyone who knows eagles realizes as did the trainer, the impossibility of unfastening this steel like grip without aid. So Kerr hung on, meantime unfastening the eagle's other foot. Immediately the bird reached out that member, sinking those talons into the same arm. And there Kerr waited in agony, the eagle suspended head down, for nearly twenty minutes until the great twenty-three-pound bird decided to drop off and fly to a safer high on the stage.

One of the prettiest bird scenes ever filmed showed an eagle fluttering its wings nervously several seconds before finally soaring away from a cliff. Such birds are notoriously obstinate, but Kerr had worked out what he considered a sure-fire way to make the eagle take wing. He tied a tiny thread to one leg, and, when the director called for action, he stood outside the camera's range and jerked the thread. With every tug, the bird fluttered its wings and on the third pull took off.

LATER in the day he and two other eagles, in company with four buzzards, were placed on nearby rocks. Invisible strings likewise were attached to their legs. When assistants jerked, the birds shifted aimlessly around, but declined resolutely to sail into the air.

Trainers often submit to severe punishment in order to gain the confidence and friendship of birds. One owner who can provide sixty species of birds and animals on short notice had frequent calls for a kissing bird. What to do? The mackaw, he decided, with its red and blue and white plumage would blend into scenes of more types than a bird of solid color.

During his early efforts the bird would mistake the movements of his lips for an invitation to peck, and for weeks the trainer withstood objections of his face. Never, however, did he give ground and at last the beautiful creature learned his master was trying to be friendly. Today the mackaw will touch his beak to an actress' lips in evident pleasure.

MANY of the most amusing situations are developed with animals who really know no direction. True, they do demonstrate trainers' ingenuity. The script of one recent picture called for a calf to bawl periodically during a conversation between two actors. Of course, this could have been accomplished mechanically had it not been necessary that the calf appear in the scene. Manifestly her sound could not be reproduced unless she actually had her mouth open at the time the camera was grinding.

On the set it was discovered that the calf would remain silent as long as it could see its mother, but would start squalling when the mother disappeared. Of course the cow could not be led offstage quickly enough for the purposes of the scene, so the resourceful trainer hid Bossie behind a curtain, reflecting her image into the calf's vision by means of a large mirror. By changing the mirror's angle, it was as easy to make the calf bawl as to turn a spitgot on and off.

Trainers of movie-animal actors personally conduct their dumb stars to the studios. Even were strangers able to direct the animals, no owner would permit such an arrangement. Not only do they wish to collect a trainer's fee, but they want to be sure, also, the feathered and furred animals will receive good treatment.

Not long ago, bystanders witnessed on the athletic field of Occidental College, near Los Angeles, the unusual spectacle of 200 dogs racing across the field yelping in delight at being released through the V-necked mouth of a coach. The strait jacket the cameras they swept, directly to a group of athletes. Soon the actors were lost in the canine melee.

You would have thought some of these animals were being killed to hear the noises. They were not suffering, though. They were enjoying themselves hugely.

THE dogs had been reared on three animal farms near Los Angeles. Each dog knew his master and could single him out of any group, no matter how large. So, when at last came the call, "camera," a gateman threw open the pen and the 200 swarmed out onto the field, found their masters among the two dozen athletes, and by their presence threw into confusion the plans in progress, thereby adding to the potential merriment of audiences around the world even though some may be unfamiliar with America's particular brand of games and humor.

Here is a bulletin recently issued by one of the big studios:

1. No animal shall be worked more than eight hours daily and all shall be fed and watered regularly.
2. No animals shall be wired. (That is, held in place by tight wires.)
3. No drugs, liquid smoke, or electric shocks shall be used.
4. No animals shall be trussed, spiked, doped, or fired.
5. No knotted wire or spiked bit to prevent free head movement shall be used.
6. No running wire, trip ropes, or pitfalls shall be used.

All of which, taken together, mean that animals must be treated kindly and with consideration, that they must be well-trained by their owners and capable of taking direction either by voice or silent cues.

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(Continued from page 36)

from its upper half. The index mirror is left fully silvered.

After placing the circular head of the radius arm in its cardboard socket, a pin should be run through the center and bent over on the back to act as a secure bearing. If you use three-ply wood, the pin may become a small wood screw.

The telescope is merely a small piece of brass tubing to direct your eye at the proper angle. In a professional sextant, this telescope, of course, contains lenses.

With care in constructing your model, you can determine your latitude with fair accuracy from the polestar or sun. However, unless this is done over water, you should select a location where there are no hills on the horizon.

IT IS needless to say that this article makes no attempt to enter into the fine points of the astronomy of navigation. As a matter of fact, the polestar is about two degrees distant from the pole, and the aim has been merely to make the principles plain by making use of them in practice, and thus giving you the thrill of finding your approximate position.

The next article will show how to make a simple equatorial telescope mounting, and a simple telescope of medium power. The method through which astronomers find stars by their right ascension and declination will also be illustrated by experiments with the equatorial telescope mounting. Also, we shall complete the astronomy of navigation by learning how longitude is determined.

Only forty of all the stars in the sky are close enough to the earth for their light rays, speeding 186,000 miles a second, to reach us in twelve years. Eight of these twelve-year stars are visible to the naked eye and eleven of them were discovered within the past decade. According to Dr. Adriaan Van Maanen, astronomer at the Mount Wilson Observatory, Pasadena, Calif., who has made a study of these nearby suns, there are at least four times as many stars in the sky as have been discovered.

SLEEPY brains are chemical factories manufacturing "hypnotoxin," a strange substance that drugs the cells of the body, according to a new study by French scientists at the University of France. He has just reported that he has succeeded in isolating hypnotoxin from the brains and spinal fluids of animals that have gone for considerable periods without sleep. In other experiments, he injected the sleep-producing substance into animals that were fresh and wide awake after a long sleep. They immediately became drowsy. The effect of the drug upon the brain cells is only temporary so far as he can determine. When the sleepy animal is given a normal amount of sleep, the drowsiness disappears. Hypnotoxin is also found in the spinal fluid during sleep. The chemical accumulates in the brain as the result of mental activity as well as of physical exertion, the tests showed. When a person stays awake after becoming sleepy, the surplus hypnotoxin collects in the spinal fluid. When the spinal fluid is removed, and until this is burned up, the depressing effect upon the body cells remains.



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TIRES TORN TO PIECES IN SAFETY TESTS

(Continued from page 32)

inch high. Operation of this machine hour after hour subjects the overloaded tires to punishment as severe as anything they are likely to meet in service.

Because heat is a prime enemy of rubber, the laboratories are kept at a constant ninety-degrees-in-the-shade temperature, so the tires will be tested under conditions most likely to subject them to severe strain.

WHEN they have been pushed almost to the breakdown point, they go to the operating room where specialists perform the all-important autopsy. Carefully dipping their knives in water, they cut through the outer layer of rubber and peel back the first fabric ply. Then, layer by layer, the fabric, saturated with rubber, is turned back until the tire looks like some strange book with its yellowish pages open.

It is on such pages that the experts find written the story of why and how tires fail. Tiny cracks and breaks in some of the layers show where the material has started to give way. By compiling data upon the points where a tire fails first, the engineers have been able to concentrate upon strengthening the weak places and thereby lifting the average of safety.

To discover how treads will wear, special tests are used. One method is known as "fingerprinting." Taking a sheet of brightly polished tinplate, the engineers coat it with ink made of beeswax, paraffin and lamp black, spreading the wax on evenly with the aid of a rubber roller. Then, placing the plate on the ground, they sprinkle over it, with a salt shaker, a small amount of granular abrasive—enough to distribute the grains one-eighth to one-fourth inch apart. Then the car is driven so that the tire to be tested passes over the plate. The tread design is impressed in the coating, and the abrasive grains, pressed against the polished metal, scratch little books as a result of the wiping action of the tread. These books are from 0.01 to 0.05 of an inch long. Examination of them through a microscope tells the research man much about the behavior of the tire tread, and often reveals the cause of excessive wear.

A curious fact about the wear of tire treads has been discovered through such researches. Many motorists believe that sand roads are particularly hard on tires. As a matter of fact, the experiments have revealed that sand often reduces wear instead of increasing it. This is true especially of some parts of the Southwest, where fine sand having rounded grains, is common. The particles act as little roller bearings and reduce friction between tread and road surface.

RIDING quality also comes in for its share of investigation when tires are being tested. The principle of the earthquake-detecting instrument, the seismograph, has been adopted for making quick checks upon the riding qualities of cars and tires and in measuring the effect of different road surfaces. The device used is known as a "comfort meter." It consists of a weight, suspended by a calibrated spring, connected to a piston moving in a cylinder of oil. A sensitive feather valve in the piston permits it to move freely in a quick but with difficulty in the other. Thus when a road shock causes the weight to move down, or more accurately, the car to move up while the weight stands relatively still, the piston moves downward without resistance but is checked in its return by the oil.

If another and another bump happens to be encountered before the piston has time to overcome the oil resistance, the weight

remains down. A pointer operating over a scale enables the engineer to read off the riding quality, or shock-absorbing ability, of any tire traveling over a known road surface.

Because the actual conditions met by a tire in service can be duplicated only on the road, fleets of test cars carry on the work from the point where the laboratories leave off. These fleets comprise trucks and passenger cars of all descriptions. They travel on every imaginable kind of road and they often run twenty-four hours a day, crack drivers taking the wheel in eight-hour shifts. The passenger cars average fifty miles an hour and cover 1,000 miles in a day.

WHEN a driver starts his day's shift, he checks the air pressure in his tires. Then, four hours later, he checks the pressure again. At the end of the run, the pressure is again checked. Every time the speedometer turns over 300 miles, the driver stops and changes all of the tires about. This constant changing, which causes a complete rotation of tires every 600 or 1,200 miles, results in the same amount of wearing action being applied to each tire on the car.

By judging inflation pressure, driving speed, and amount and distribution of the load, the tire engineer can test any part of the tire he desires. Thus by under-inflating a truck tire, increasing the load to 150 percent of normal, and having the driver maintain a speed of about thirty miles per hour, he can cause the carcass, or internal fabric structure of the tire, to receive the greatest punishment.

Traveling about the country day in and day out at the rate of a mile a minute may seem like a hazardous occupation, but accidents are almost unknown in a test car fleet. Routes are selected so as to avoid heavy traffic. Machines are inspected constantly and repaired instantly if a defect is found. And the drivers are kept physically and mentally fit. So successful have been the test car drivers of one high-speed fleet that they have traveled a million miles for every accident involving property damage of \$150.

In the winter, the testing fleets head south or west. Because tires wear longer when there is ice, snow, or even water on the roads, tests made under winter conditions would extend over several times as many miles as those made in summer.

However, one spectacular form of tire testing does take place in the north during cold weather tests of the anti-skid characteristics of cars on ice-covered highways—tests that are essential to safety in driving.

DURING such tests, as well as in the laboratory work-room, new facts about tires and how they behave have been uncovered.

For instance, did you know that the average tire is completely off the ground a third of the time when a car is going fifty miles an hour? Even on good pavements, the tests of the research men have shown, a tire is constantly bouncing or oscillating up and down. The tiny jumps occur rapidly, approximately a twelfth of a second being required for each leap off the ground.

Again, the experimental work has shown that a new tire has to be broken in just like a new automobile. After 100 miles of use, your tire is more efficient and flexible than it was on the day it was bought. This is because the tire leaves the factory with a thin, hard skin on the surface of the tread, the result of overcuring the mold "dope" into the rubber and the later application of protective paint. It is after this tough skin has worn away and the casing has limbered up, that the tire gives its best service.

LIGHT FOILS RARE-STAMP RACKETEERS

(Continued from page 24)

So the racketeers make fake perforations along the straight edges by cutting out tiny half circles exactly matching the perforation marks on the other sides. Under the expert's microscope the projections on the different sides of the stamp are shown magnified hundreds of times. Those left between the half circles of the fake perforations have clean-cut, straight edges while those left where the stamps have been torn apart have fiber fraying sticking out and ragged edges.

Special perforation pages, containing rows of different-sized black dots, enable the expert to check up quickly on the type of perforation used in any given stamp. In the United States, the standard for ordinary issues is eleven and ten and a half perforations for every two centimeters. Some years ago, when Fournier of Switzerland, the ace of stamp counterfeiters, died, it was discovered that he had produced a complete set of homemade tools to reproduce every known type of perforation.

SOMETIMES, I was told, instead of putting on perforations, the faker takes them off. An example of a stamp worth more with only two sides perforated is the 1907 United States coil stamps issued for use in the first vending machines. They appeared not as a special issue but as ordinary stamps with the sides straight-cut. Collectors did not awake to the fact that they were different from the regular issue until the stamps had become relatively rare. When the demand for these stamps arose the stamp fakers proceeded to supply it by cutting off the perforations of ordinary stamps of this date and selling them as coin-stamp originals.

In other cases, stamps have been cut in half to enhance their value. Years ago postmasters in Canada and the United States sometimes cut two-cent stamps in half, for example, to make one-cent stamps when they temporarily ran out of the stamp of lower denomination. One 1847 bisected ten-cent stamp, postmarked "Concord, N. H.," now has a value of \$1,250, while an ordinary ten-cent stamp of the same issue is worth only \$25. Such specimens are much sought after. However, collectors want them "tied to the cover," that is, attached to the envelopes with the postmark running off the stamp onto the paper, to indicate they are genuine.

A few months ago, a Canadian stamp faker sent a New York dealer half a dozen bisected stamps tied to ancient 1858 envelopes with apparently genuine postmarks. But, by a curious oversight, he wrapped the stamps in a piece of paper on which he had tried out his counterfeit rubber cancellation stamp and had obtained half a dozen clear imprints of the identical postmarks carried by the stamps!

ONE of the most difficult things for an expert to expose is a fake surcharge, or imprint on the face of the stamp raising or lowering its value or designating it for special service. Many of the early air-mail stamps were made by surcharging ordinary issues, the most famous being the 1919 Hawker. It was issued in Newfoundland when Harry Hawker, the British pilot, attempted to fly the ocean shortly before Alcock and Brown succeeded.

Forced down in mid-Atlantic, the flyer and his mechanic were picked up by a tramp steamer, which carried them wirelessly, and reached Europe days after they had been given up for dead. By a curious twist, the mailbag, which had been left floating in the ocean, was picked up by another vessel. The value of the stamps it contained is now something like \$100,000 apiece.

As it is comparatively easy to print a fake

surcharge on an ordinary stamp, special care is taken with rare stamps of such issues. The latest method of ferreting out fakes of the kind is to place a known genuine stamp beside the submitted one under ultra-violet light. Unless the inks used in printing the surcharge are identical, they will fluoresce, or glow, in different colors. The printing is also gone over with precision scales, and looked at under pieces of glass ruled off into millimeter squares and concentric circles a millimeter apart, to detect variations in type and spacing. Sometimes the ink is examined chemically.

FREQUENTLY, the cancellation is the key to a forgery. Many stamps are worth more when they have been cancelled in a certain place or in a certain way, and such postmarks are imitated by the fakers. There is the case of the United States twelve-cent issue of 1856. A few, having green cancellations, are worth five times as much as those which are postmarked in the ordinary black. On several occasions, attempts have been made to wash off the black ink and substitute green. Such work would be comparatively easy and would fool the naked eye. But it wouldn't fool the latest apparatus of the experts.

By placing the bits of paper under ultra-violet light and by photographing them with special color-sensitive plates, the experts can determine where chemical erasing has been done. In fact, in at least one instance, the black light rays were too effective. This was in the case of the "ghost" postmark found on stamp in the collection of a famous philatelist.

When his stamps were being examined by an expert, the faint but certain print of a postmark became visible under ultra-violet light on the face of a rare, supposedly unused stamp. The collector thought he had been sold a doctored specimen from which the postmark had been removed. But a curious solution was found to the mystery. A few years before, he had rearranged his album. The questioned stamp had taken the place of another specimen which was a used one. On the back of the opposite leaf, the postmarked stamp had left an invisible ghost print which was transferred back to the surface of the unused stamp by the pressure of the leaves. Although the ink marks were so faint that a magnifying glass failed to detect them, the ultra-violet rays brought them out.

THE two most popular forms of stamp faking today are removing cancellations and repairing damaged stamps. Torn or damaged specimens can be bought for a small fraction of the price of perfect ones. So, by extremely delicate work, underwork stamp surgeons patch up tears, plug in holes, put on corners, turn center vignettes upside down, to produce apparently perfect copies or to enhance the value of various specimens.

I learned of one instance in which parts from four damaged stamps were combined to produce what passed at first glance for an authentic copy.

In some European countries, stamp repairing is considered a legitimate profession. There, specialists have developed amazing skill at combining, altering, and improving stamps to dress up a collector's album. Frequently, such stamps find their way to America, after the collector's death, and add to the problems of the expert.

But, almost invariably, by employing his knowledge of stamps, his collection of reference volumes, his comparison specimens and the latest aids to scientific investigation, he is able to separate the real from the spurious and to detect even the most cunning of the counterfeiters.

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Freak Vehicles for Air, Land, and Water

(Continued from page 27)

In the United States, advertisements appeared in various publications setting forth in glowing terms the virtues of the Cynosphere. "It is of light and graceful mechanism," they read, "so it can be used by ladies and children as well as by gentlemen. For pleasure purposes, it is unsurpassed and its moderate expense brings it within easy reach of all. When it is fully introduced to the American public, it is destined to attain greater popularity than that now held by the velocipede!"

An even queerer attempt to utilize living motors is contained in a balloon patent issued in the United States in 1881. By fitting birds with corsets, the inventor planned to steer his dirigible through the sky.

Eagles and vultures, wearing these harnesses, which left them free to flap their wings, were to be mounted on rollers so they could be moved about to lift at the right place and guide the nose of the aircraft up or down, to left or right.

A wooden snake and a bumblebee suggested two other strange vehicles of the air to early experimenters. In the West, a mechanic worked for seven years upon a dirigible with a bag made up of segments like the sections of a toy snake. The idea was that the leading section would steer the ship, the others following like a train rounder a curve.

The bumblebee craft was the product of a Belgian inventor. It was a flying machine with an immense air-sack at the rear, looking like the segmented abdomen of an insect. In landing, the machine was supposed to drop backward to the ground, striking on this air-bag, the segments of which would telescope together to break the fall!

In the early days of railroading, a mule was the inspiration of a queer idea in connection with transportation. Trainmen in the Southwest had to make frequent stops to drive mules and cattle off the track. This was the cue for a Kansas inventor to step forward with his patented mule-remover.

It was a stop-cock arrangement to be installed on the front of the locomotive and operated from the engineer's cabin. When a mule appeared on the track ahead, the engineer would pull a lever and out would squirt a hundred-yard stream of hot water that would clear the track. To take care of animals on the turns, the gadget was arranged so it could be shifted from side to side to shoot around curves as well as in a straight line!

Sometimes, one of the men laughed at innovators was actually skirting the borders of a great invention. Such was the case with Peter Nissen, the Chicago accountant, and his "Foolkiller III," undoubtedly one of the weirdest vehicles ever conceived.

In the early years of the present century, Nissen was seeking a way to reach the North Pole. One of his schemes for traversing the rough Arctic ice was to use an automobile equipped with huge, low-pressure tires. Thus, thirty years before this time, Nissen dreamed of the modern balloon tire. Unfortunately for him, he didn't stop there. The idea of the balloon tire kept growing in his mind. It got bigger and bigger and eventually the automobile disappeared from his plans and only the tire remained!

This was his fantastic scheme: He would construct a canvas bag, 115 feet long and seventy-five feet in diameter, fill it with hydrogen gas and sail as far north as possible. Then he would let out the gas, detach the car and, carrying it inside through a trap-door in the canvas, attach it to a central axle held in place by ropes radiating out to the envelope.



The California mechanic who designed this dirigible intended to steer it without a rudder by moving the large leading section

Climbing into the car, he would start a suction pump and fill the huge bag, higher than a six-story building, with air. Then he would let the wind roll him across the ice toward the Pole!

By sliding the car along the axle from one side to the other, he planned to alter the course of the rolling bag. If the wind shifted, blowing from the wrong direction, he would deflate the envelope and anchor it until the breeze again favored him. Then reinflating the immense football, he would roll on toward his goal. With the pump keeping the internal pressure of the bag at about one-half ounce per square inch, Nissen figured he could roll over masses of ice as big as a small house without a jar and could run smoothly across snow and open water even in the grip of a seventy-five mile an hour blizzard.

To test his idea, Nissen built three experi-

crawled into the canvas ball and sealed the opening. At the stuffed point from within, helpers released the envelope and the huge ball rolled down the shore and into the water, growing smaller and smaller until it disappeared over the eastern horizon. During the night, the wind reached fifty miles an hour and it grew bitter cold. Two days passed without a word from the canvas ball. Then, hunters on the eastern shore of the lake, nearly a hundred miles away, found Nissen's frozen body and remains of the strange vehicle that had carried him to death.

In one of his pockets was a card bearing the scribbled words: "Air hose has broken. N." The "Foolkiller III" had survived the storm and had crossed the lake. But the defective hose had allowed it to become partially deflated so it had failed to roll up on the sand out of the pounding surf. Nissen had cut his way out of the envelope. Then, weakened by the bitter cold and exhausted by his struggle with the surf, he had perished on the shore.

Imagine a trip to the North Pole pulled by a kite! That was the journey envisioned thirty years ago by an English experimenter, S. F. Cody, who later made one of the pioneer airplane flights in the British Isles. Before, the Norwegian explorer, Fridtjof Nansen, had returned with the report that he had been stopped before reaching the North Pole by a wall of ice 125 feet high. Cody suggested that kites could be used to lift sleds and supplies over such a barrier as well as to pull them along the level ice. As proof of his contention, he constructed a curious kite-driven boat and crossed the English Channel in thirteen hours, pulled through the water by his aerial power-plant.

That was in 1903. In the same year, one of the strangest of these curiosities of transportation appeared, also in England. It was a walking steam-engine. Its inventor called it the Pedrail. Instead of ordinary wheels, this footed locomotive had a series of heavy, circular metal blocks, suggesting elephant hoofs, facing outward around the rim. As they neared the ground, the mechanism within the wheel brought them into position so they were planted firmly and the engine advanced on an endless procession of steel feet. In tests, the Pedrail climbed over stones and timbers put in its way.

Even the wildest plan in this realm of constant flux cannot be dismissed without consideration. Nothing in all this recital of mechanical oddities appeared more absurd or outlandish than did the autogiro when it first appeared on the horizon of invention. Yet, today, the flying windmill is an accepted feature of the airways.

During the last century—a hundred years of amazing advance in comfort and speed—the inventors of strange, surprising, often fantastic vehicles have played a little-appreciated part. For without realizing it, the world is frequently indebted to their dreams for stimulating other workers and to their pioneering for opening new paths of research.

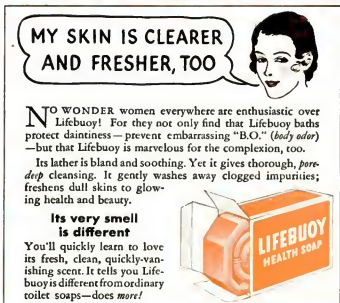
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